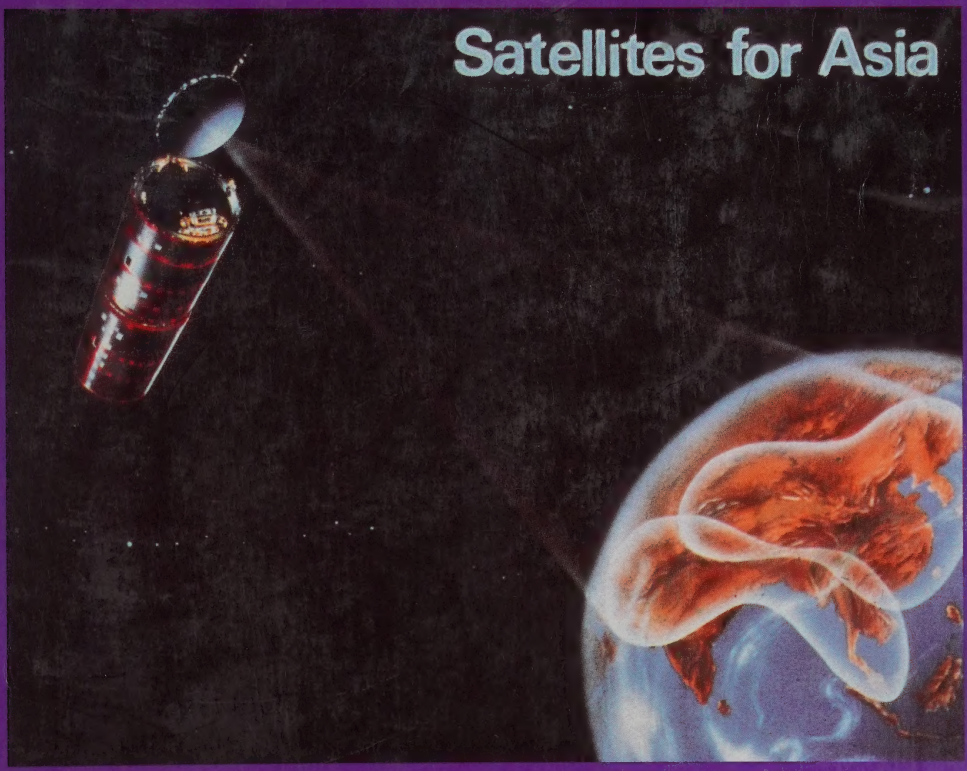
The World of SATELLITE TV

BY MARK LONG & JEFFREY KEATING

INTERNATIONAL EDITION FOR
ASIA, THE MIDDLE EAST, & THE PACIFIC RIM



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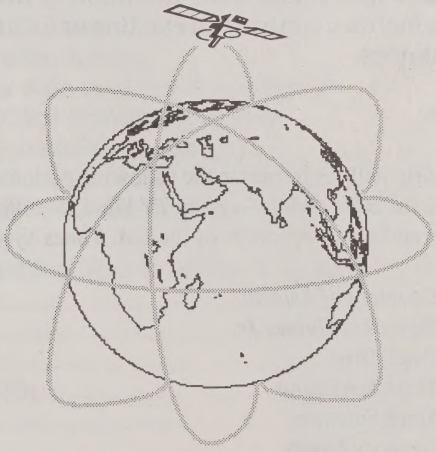

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Foreword

When the history books are written for the 20th century, it is my opinion that the subject so well covered in this book, direct home reception of satellite television, will emerge as having had an effect equal to that of the automobile. It was a total surprise—even to those of us who have been involved from the beginning in the engineering and planning of space technology—that widespread use of private receiving terminals would occur so early in the 1980s. The result has been dramatic both in technical advances and price decline.

The invention of the transistor, like all non-linear advances, was simply not foreseeable. Nor was this present satellite TV revolution. Even after the invention of the transistor, none of us could imagine the marriage of materials, science, physics, the computer, and industrial technology which would give us the ability to build transistors with such short paths and so few connections that the amount of noise contributed by the transistor would be miniscule. Translated into consumer terms, yesterday's high-priced low noise amplifier is now a two hundred dollar unit with performance beyond even the wildest dreams of a few years past.

Through such developments in solid state physics coupled with similar advances in the complexity and reliability of the satellites, we, as engineers, can see how it is technically and economically possible to make wide-band information available in the form of television, audio, and digital data to every human being on Earth.

Technology generally advances not because of planning, but because like the mountain, "it's there". Our microwave technology is now so well developed that it is no longer necessary to treat it as magic—we can ignore it in the same way that we ignore gravity. However, it cannot be ignored by our social and political planners any more than they can ignore the fact that they sit down in chairs rather than drift about the room. It is important that everyone have some understanding of at least the technical possibilities and the social implications so that we can make effective use of the technology.

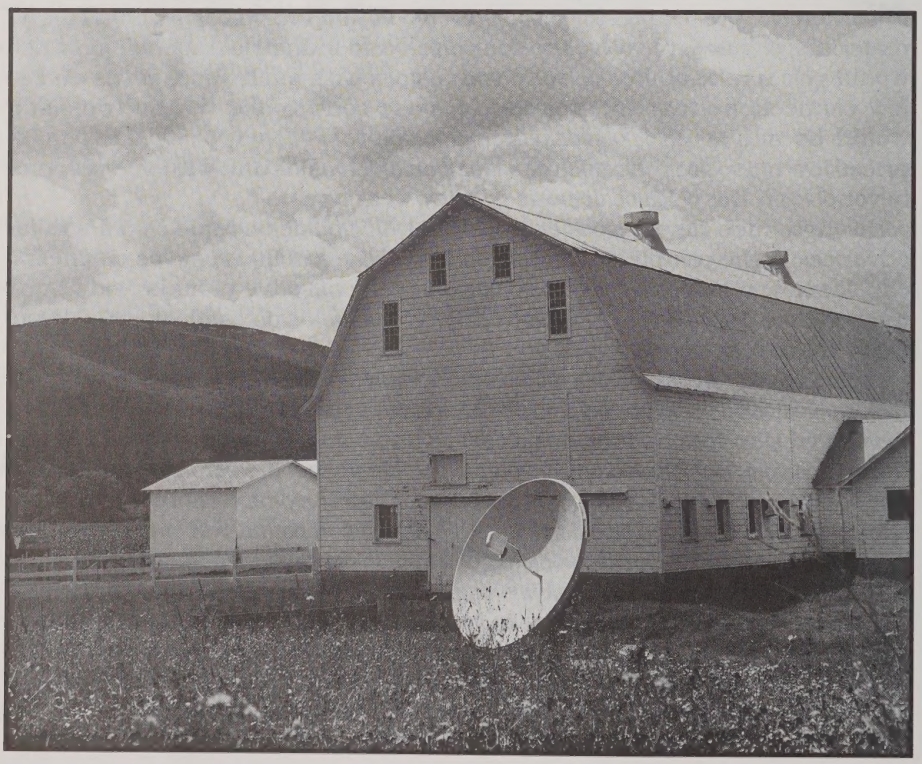
Readers of this book will come to realize that they are looking at a system which has reached technical maturity and already has made a major impact on humanity. The unification of Germany and the fall of the "Iron Curtain" were due in large measure to the power of satellite technology.

With this book you have bought a ticket for a launch into the future—a

rocket to much personal enjoyment—but also to a place from which you may be able to contribute to both the technology and its beneficial effects. Only those who read and then advance to having their own satellite TV system will be able to make an intelligent assessment of what this truly marvelous technology can mean to mankind.

H. Taylor Howard
Professor Emeritus, Stanford University &
Director of Research, Chaparral Communications

Fig.0-1. Millions of people who live in cities, small towns, or in rural areas that are beyond the reach of cable now can have access to the world of satellite television. (Courtesy 3M Antenna.)



Introduction

Fifty years ago, the advent of the "little screen" radically transformed the world's entertainment landscape. The changes wrought by the introduction of broadcast television were staggering, forever changing how we see both ourselves and the world in which we live. Well, hold on to your hats, because here we go again! Standing traditional broadcast TV on its head, the present-day satellite TV revolution is delivering crystal-clear pictures and high quality sound into millions of living rooms throughout the globe.

Satellites have become the superhighways of the Information Age. The changes they have brought to our lives are as dramatic as those from any other technological development in this century. Boundaries of money, nation, time, and space are dissolving in the cooperative linkage of the entire world which is sharing the resources and technology of space.

At this very moment, distant communications satellites are beaming a continual stream of news and entertainment into our backyards. To tune in, all you need is a bowl-shaped antenna called a dish and an electronics package that converts futuristic satellite transmissions into signals that can be displayed by your regular TV set.

Sounds like a dream? It isn't. More than ten million households worldwide already own satellite dishes. Not all of these satellite dish owners live in rural areas, either. Many urban and suburban households that could access local cable TV systems are tuning in to satellite TV instead. The reason? Satellite TV can give you interference-free, studio-quality reception, which is worlds above what most of us can pick up from our local broadcast and cable TV affiliates. Complete freedom of choice is another important area where satellite TV wins hands down. You get to choose the services and special events that *you* want to watch, instead of opting to let your local cable company make these choices for you.

When you own a satellite dish, literally dozens of TV and radio channels are just the push of a button away. As you hop from satellite to satellite, you will encounter one box office extravaganza after another. Recently-released smash-hit movies that are uncut and uninterrupted flash onto the screen, along with critically acclaimed films and movie classics. There are dozens of major sports events in virtually every field to choose from, including live professional and collegiate competitions, the Olympics, World Cup Soccer, and the Goodwill Games. What's more, you can access coverage of your favorite sports teams—even if the events are blacked out in your local area.

You also will be dazzled by a flurry of up-to-the-minute news and weather reports, children's programming, and music videos. Local TV stations from big cities such as Bangkok, Kuala Lumpur, and Tokyo—also can be received from anywhere in the region.

A home satellite dish puts you in the studio control room, where you can choose from a variety of live, unedited news feeds that originate right from the scene of the action. It is a common occurrence to see news reporters rehearsing their lines or getting their makeup touched up as they wait to deliver their stories, or to overhear fascinating comments that weren't intended for reception by the general public.

This book is not only a guide to the exciting new TV services coming your way via satellite, but also a detailed manual for the selection and operation of your own personal system. A home satellite dish not only will serve to entertain you and your family, but also will offer you immediate access to information from around the world. This book will show you how the satellite network functions and explain in simple terms the esoteric electronics, so that you can get a basic understanding of how it all works. We also review the latest generation of satellite television technology, direct broadcast satellites (DBS), which already has become a major force in TV broadcasting in Japan.

Satellite technology is showing us that we are no longer a planet of isolated peoples and cultures: we now live in a real global village. This special edition of *The World of Satellite TV* reaches beyond Asia and the Pacific Rim to provide detailed information on satellite systems for the Middle East. We also explain how to receive a wide spectrum of international programming both at home and at other locations within the region.

You don't have to be an expert to get involved in satellite TV; it can be as simple as calling your local satellite retailer for a turnkey installation. But even then, a good understanding of the technology allows you to make an informed choice, and to get more out of your home system. This manual will help you get started, and will serve as a handy reference guide to the world of satellite TV.

Chapter 1
Exploring the Satellite Galaxy

In October of 1945, a gifted science and science fiction writer proposed the extraordinary idea of using stationary satellites to beam television and other communications signals halfway around the world. Arthur C. Clarke (*2001: A Space Odyssey, Rendezvous With Rama,* etc.) realized that if a satellite were positioned high enough above the equator, its orbit could be matched to the rotation of the Earth. The satellite would then appear to remain fixed in one particular spot in the sky. Because a satellite's orbital speed varies with its distance from Earth, a "geostationary" orbit is only possible directly above the equator, in a narrow belt about 22,300 miles out. Although it took the technology a while to catch up with Mr. Clarke's concept, today there are a number of satellites taking advantage of his original thinking. In recognition of his pioneering vision of satellite telecommunications, this band of outer space "real estate" is called the *Clarke Orbit.*

Mr. Clarke also realized that a single satellite located above the United States could effectively replace thousands of local transmitting facilities at a mere fraction of their cost. He first raised the possibility of direct satellite-to-home reception as the most efficient means of supplying television and radio programming. At first this idea was not taken very seriously in the scientific community, probably because it had been expressed by a writer who dabbled in the art of science fiction. But science fiction is often a springboard for new ideas and theories, some of which turn into science fact.

In 1957, the Soviet Union launched Sputnik, the world's first artificial satellite. Although it only transmitted a simple beacon that could be tracked as the satellite orbited the Earth, its successful flight had implications that challenged the rest of the world to develop the advanced technology necessary for the exploration of space.

Several additional technical developments were necessary in order to make satellite communications possible. Solar panels composed of thousands of tiny photovoltaic cells enabled these remote relay stations to generate their own electricity from the Sun, providing the satellites with reliable operating power. The invention of first the transistor and then the integrated circuit allowed technicians to miniaturize all of the components so that a relatively small and lightweight package could be launched into high orbit.

In 1962, the United States launched Telstar, the world's first satellite used for television programming. Because satellite launching techniques were still in their infancy, Telstar was not put into geostationary orbit. Its elliptical orbit had to be tracked by ground stations, and it was only overhead during a portion of each day. In 1965, the Early Bird satellite became operational as the first commercial geostationary satellite; it relayed telephone calls, telex, news and other television programming from one side of the Atlantic to the other. It also could carry 240 telephone communications, or one television channel, at a time. Early Bird was the forerunner of a new series of satellites operated by the International Telecommunications Satellite Organization (INTELSAT). First Canada, then the United States, and subsequently other countries constructed their own domestic satellite systems. Each new satellite had greater capabilities, expanding our ideas of the technologically possible, and by 1992 there were more than 80 geostationary domestic satellites serving 15 different countries from around the globe.

Uplinks & Downlinks

Each satellite is both a receiver and a transmitter. First, a ground station, also called the *uplink*, sends a signal to the satellite. The satellite automatically changes the signal's frequency and retransmits it back to stations on the ground. This second signal path is called the *downlink*. A satellite is much like a broadcasting tower 22,300 miles high, an automatic relay station that can transmit into an area as large as 40% of the Earth's surface.

Each satellite has a number of redundant modules which are spares that can be switched into

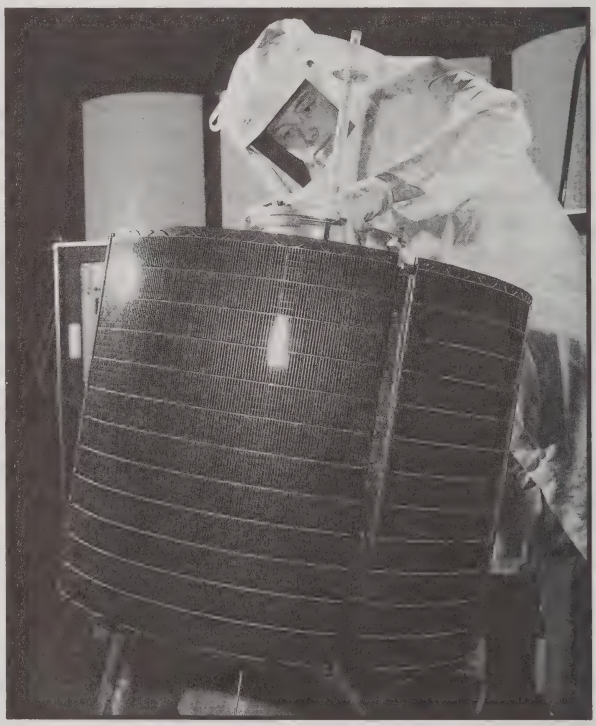


Fig.1-1. Early Bird. (Courtesy INTELSAT).

operation in the event of any malfunction of the primary parts. A satellite costs US$ 100 million or more for the bird and launching rocket—too expensive a project to allow parts failure to disrupt the services. Not many repairmen will make a service call to the Clarke Orbit. But ground control stations can remotely switch in backup facilities in case of failure.

Satellite Transponders

Every satellite serving the Asian region has several channels, called *transponders*, that process communications traffic. A satellite can have 24 or more transponders in operation, each capable of transmitting one TV signal or thousands of simultaneous telephone conversations. Radio networks are also present on many transponders, as well as teletext news, computer information services, and other data transmissions.

Every transponder's signal is also polarized. Signals of opposite polarization are received separately at the receiving station. Polarization allows more channels to fit into the limited range of frequencies allocated for the satellites. Many satellites have 12 horizontal and 12 vertical transponders which overlap each other without causing interference.

Satellite transponders operate on frequencies high above those used by the regular TV channels.

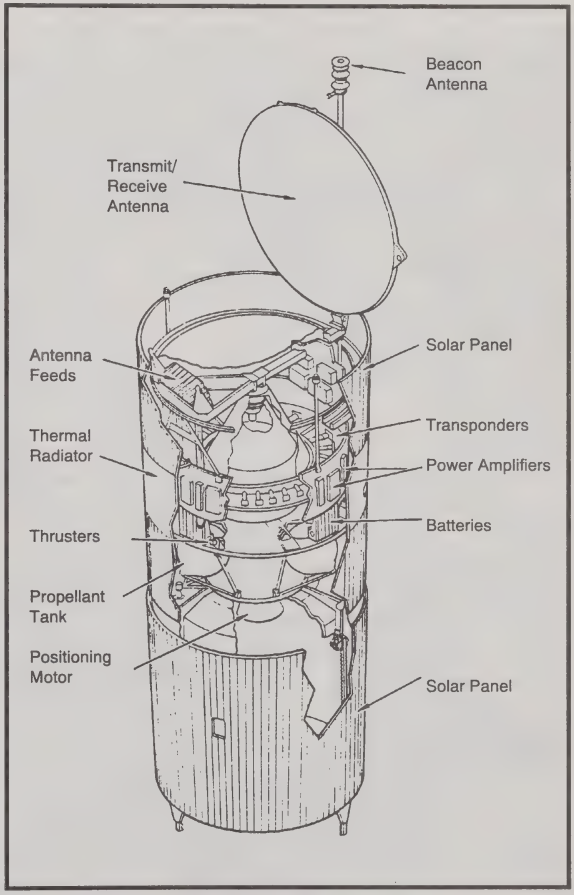


Fig.1-2. Inside view of the Asiasat communications satellite.

Since these super-high frequencies are not affected by adverse weather conditions or sunspot activity, satellites offer extremely reliable communications coverage 24 hours a day. Operating at frequencies of several Gigahertz (GHz†), satellite transponders relay their microwave signals via two distinct communication bands. The majority of Asia's home satellite TV services are using the range of frequencies from 3.7 to 4.2 GHz, often referred to as the "C" band. In Japan and Australia, however, satellites operating within higher frequency spectrums ranging from 11.9 to 12.0 GHz and 12.25 to 12.75 GHz are broadcasting satellite TV programs directly to Japanese and Australian homes. Future satellites planned for launch by Thailand and South Korea in the mid-1990s also will use these higher frequencies to transmit TV programs directly to home satellite TV systems. The entire spectrum of frequencies ranging from 10.95 to 12.75 GHz is referred to as the "Ku" band.

† Hertz (Hz) refers to the number of cycles or waves per second of a given signal. 1 MegaHertz (MHz) = 1,000,000 cycles per second (cps); 1 GigaHertz (GHz) = 1,000,000,000 cps.

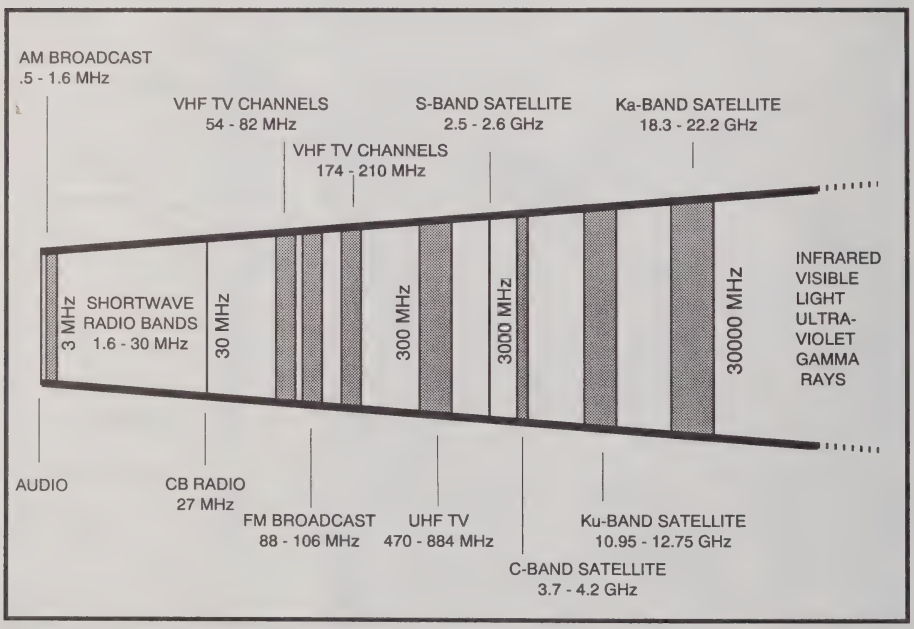


Fig.1-3. The electromagnetic spectrum.

Footprints

The satellite's antenna transmits the television signal in a particular shape, called a *footprint*, pointed at its coverage area. Each satellite has its own characteristic footprint, with the signal strongest at the center and diminishing outward from there. Those who live in the center of the footprint can receive the signals with a smaller dish antenna than those out on the edges. A person in Japan may need a 10-foot antenna to receive the same quality picture as an individual in Thailand with an 4-footer. The most common home satellite dishes are 6 to 12 feet in diameter.

C-band satellites transmit low power signals, usually in the neighborhood of eight to sixteen watts—only about as much as a car tail-light bulb uses. By the time the satellite signal reaches you, it is very weak indeed. That is why such a large dish antenna is necessary to pull the signal out of the background noise.

Today's Ku-band satellites transmit medium-powered signals, usually in the neighborhood of twenty to fifty watts.

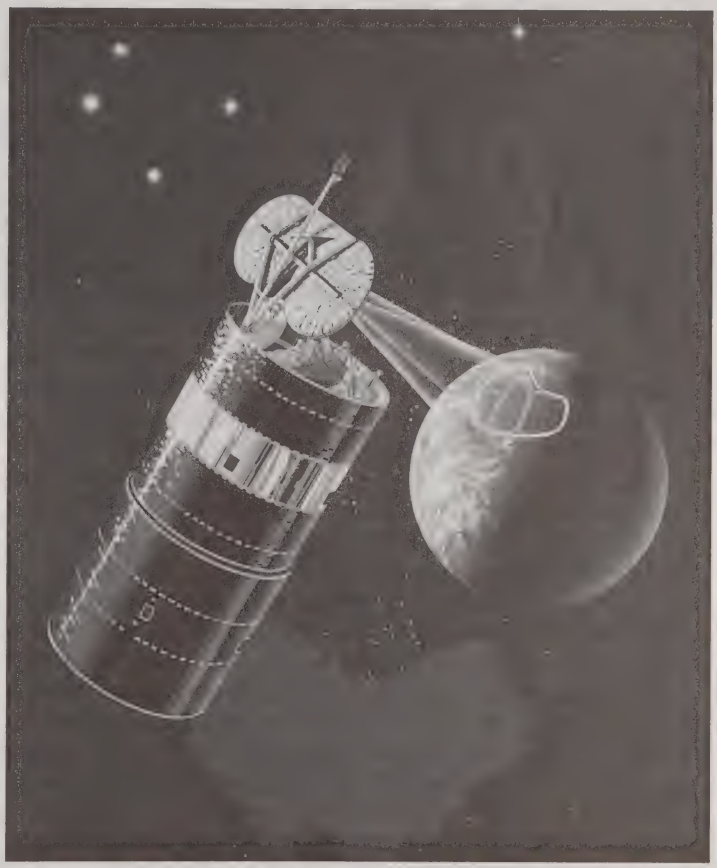


Fig. 1-4. Aussat satellite beam coverage. (Courtesy Hughes Aircraft.)

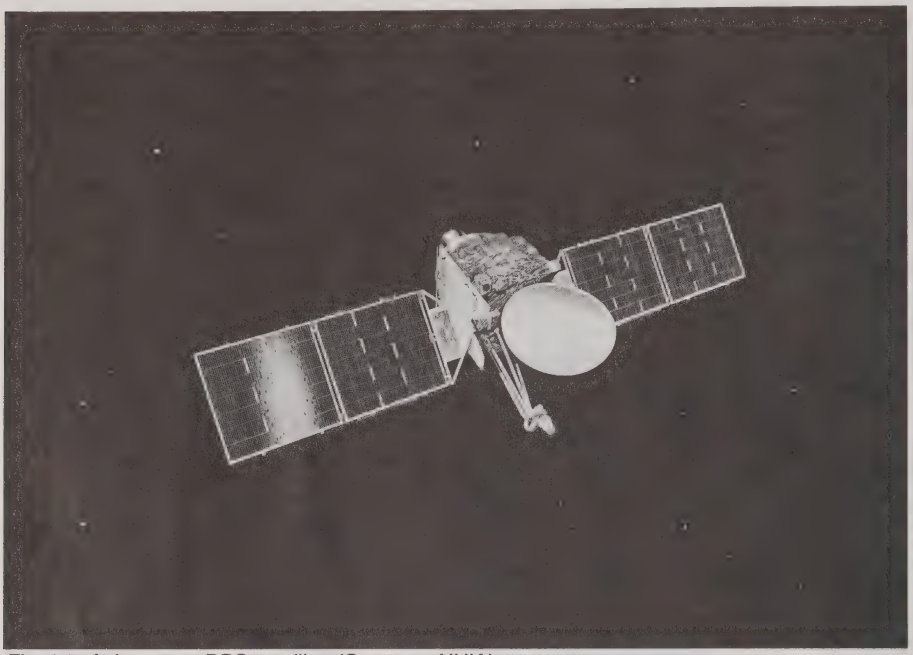


Fig. 1-5. A Japanese DBS satellite. (Courtesy NHK.)

In Japan, high powered DBS satellites are transmitting 100 watts of power per channel. Higher power from the satellite directly translates into smaller dishes down on the ground—as small as 18 inches in diameter.

The Road to Home Satellite Reception

In the 1960s and early 1970s, satellites were the exclusive domain of various government-owned telecommunications authorities which had the wherewithal to transmit TV programming via satellite. Reception of these early transmissions required extremely large parabolic dishes and expensive electronic components, which only the national PTTs could afford. It wasn't until 1975 that private individuals attempted to directly receive satellite TV signals via a backyard "earth station".

At that time, an American satellite (ATS-6) was leased to India for an experimental project that transmitted television programming into satellite earth stations located in remote villages across the subcontinent. English amateur radio enthusiast and BBC technician Stephen J. Birkill learned of the project and set out to build his own receiver and antenna for these

transmissions. His initial reception of these transmissions in December of 1975 was the first home satellite TV reception anywhere. From well outside the satellite's footprint, with a five-foot antenna made from screen, he proved that private individuals with limited resources could still bring satellite television into their own homes.

Fig. 1-6. World's first home satellite TV reception. (Courtesy S.J. Birkill.)

Back in the United States, Home Box Office and Ted Turner's WTBS began transmitting their respective programming services via satellite to American cable TV systems. Other American program services soon joined HBO and WTBS on Satcom 1—America's first cable TV satellite.

Several people within the American cable and electronics industry began to think about the possibilities of direct home reception. Robert Cooper, then editor of the U.S. cable TV industry's *CATJ* magazine, obtained an experimental license from the FCC that authorized the installation of a satellite receiving system at his home in rural Oklahoma. In an October, 1978 issue of *TV Guide,* he brought the potential of home satellite TV to the attention of millions of Americans.

Some of the more technically inclined followed the lead of American experimenters such as Taylor Howard and Bob Coleman, who already were modifying surplus telephone and military equipment with home-brewed circuitry to pick up the satellite signals for a few thousand dollars. Others yearned for a home satellite TV industry that could mass produce low-cost equipment.

The explosion in demand for satellite-delivered cable systems caused the electronics industry to increase production, which dramatically reduced the cost of some of the more sophisticated items essential for satellite reception. Through increased production, manufacturers also were able to obtain higher performance levels from their products, which made it easier for small dish antennas to provide good results.

In 1986,U.S. programmers such as Home Box Office and CNN began to

market their satellite services directly to American home dish owners. The marketing of programming services directly to American viewers with home satellite TV systems has become a huge industry.

The Advent of Home Satellite TV In Asia

On April 7, 1990, Asiasat 1—the first commercial communications satellite designed for Asian countries—was launched into space by the China Great Wall Industry Corporation's Long March 3 rocket. The satellite, which generates two regional beams centered over mainland China and Southeast Asia, was designed to transmit as many as 24 satellite TV channels.

On April 19, 1991, Hong Kong's Hutchvision began using Asiasat to transmit a multichannel Asian television service to cable and home satellite TV systems located in Asia, India, and the Middle East. Today, STAR TV (for Satellite Television Asian Region) transmits news, sports events, music videos, movies, and general entertainment programs. Moreover, STAR TV offers multiple-language audio transmissions of the BBC World Service.

Other nations also have elected to use Asiasat to transmit their domestic TV programming. These additional channels include the national TV services of Pakistan, the People's Republic of China, Myanmar (Burma), and Mongolia.

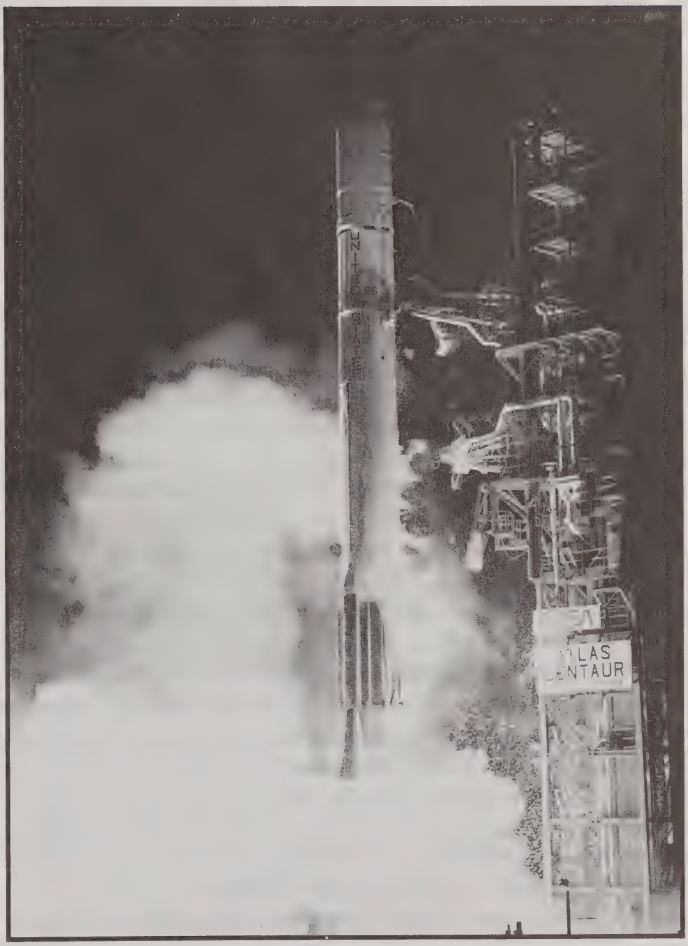
In April of 1992, CNN International and ESPN began using the Palapa B2P satellite to test Asian versions of their American cable TV services. CNN intends to market its programming to Asian satellite dish owners once a suitable infrastructure for billing and legal approval for each individual country within the region can be established. ESPN's programming—which will consist of time-shifted coverage of American events as well as regional sports competitions—initially will be offered to the company's broadcasting and cable TV clients without the Asia/Pacific region. However, ESPN has not ruled out serving Asian satellite dish owners in the future if governments in the region will permit it.

CNN and ESPN join several other TV services already carried by Palapa B2P, including System Televisyan Malaysia (TV3), TV1 Malaysia, RCT1 Indonesia, Army TV Thailand (Channel 5, Bangkok), and BBTV Thailand (Channel 7, Bangkok). Palapa B2P is scheduled to be replaced by the new Palapa B4 satellite following its successful launch by a McDonnell Douglas rocket in mid 1992.

Now the cost of owning an earth station is lower than ever before, offering new innovative features that allow you to cruise effortlessly from satellite to satellite and from channel to channel, all by wireless remote control. Not limited by the boundaries of space and time, a personal satellite system will serve as your gateway to the "Global Village" and beyond.

Chapter 2
The World of Satellite Entertainment

Today's communication satellites are owned and operated by large organizations such as INTELSAT, Asiasat, PK Telkom Indonesia, and the government of the People's Republic of China. These entities assume the initial cost of building, launching, and operating a satellite—over US$100 million in some cases. They are authorized by government-controlled communications agencies to "sublet" transponder time to smaller companies on a "common carrier" basis, where the satellite company is the



2.1. A satellite launch. (Courtesy General Dynamics.)

carrier and the user provides the programming.

Satellite television transponders are used by broadcasters and cable TV programmers to instantaneously relay programs to their TV affiliate stations within the region.

National broadcast TV networks serving Thailand, Malaysia, Indonesia, the Philippines, Japan, Australia, and the People's Republic of China, use satellite transponders to provide regular program feeds to their affiliate stations. Moreover, additional satellite transponders are used whenever necessary to relay live and unedited versions of breaking news stories and major sporting events from remote locations back to the main network studios. These "occasional-use" feeds can be accessed by anyone with a satellite TV system.

Asiasat's STAR TV channels have been created with both cable and satellite TV viewers in mind. These include news, sports, music videos, movies and other entertainment services. As the popularity of satellite TV increases in Asia, additional services for home dish owners inevitably will appear in the years ahead.

Test Patterns

Not all satellite transponders are in use on a continual basis. When an "occasional use" transponder is not carrying a particular feed, it often displays a color bar pattern called a test pattern. These often indicate what service will be operating there, occasionally even displaying information on programming content, source location, the start-up time, and other instructions. Test patterns show that the particular transponder is performing adequately, and allow technicians the opportunity to check equipment adjustments prior to the upcoming feed. There is a wide variety of test patterns in use, many of them quite colorful.

Satellite News Feeds and Occasional Video

It is a common occurrence to see news commentators getting ready to feed on-the-spot news coverage back to their main studios. The technicians must have their equipment in operation prior to the actual use of the feed to insure that everything is working properly. So it is frequently possible for you to see reporters on assignment rehearsing their lines or having their make-up job retouched. Satellite TV lets you go behind the scenes and find out things you'll never hear on the regular programs!

Satellite watchers have instantaneous access to news information coming from the world's hot spots, often long before their local evening news broadcasts. The networks involved can lease transponder time for short

periods to transfer these news feeds from one area to another. When major international news stories are occurring, many satellite transponders which are normally inactive will suddenly burst into a frenzy of video reports that will criss-cross not only the region but the world as well. Sometimes on international news feeds, the particular video may be relayed through several satellites before it reaches its final destination.

When an international news event of major significance occurs, there is a scramble by news teams all over the world to provide on-the-scene information for the folks at home. Many times the satellite uplink facilities for transferring these programs are quite limited, so the networks form a "pool" and share them, often only changing the background drop behind the news commentator as they switch from one news source to the next.

To insure that news feeds are received perfectly, the technicians in the field will sometimes rewind and replay these short segments several times to make sure that the overseas studios have received it. That's right, with a personal satellite earth station you'll get to see the news forwards and backwards!

Large businesses also are beginning to use satellite television as a means of informing their sales or management personnel on new developments with products or services. Some organizations are using satellite television as a substitute for expensive national meetings or conventions. A number of regional sites can be hooked up to a satellite, allowing people to see and hear each other. With the downward trend in satellite rental fees, *teleconferencing* has become a money-saving proposition.

Satellite TV Programming

Private individuals can now use home satellite TV systems to receive a cornucopia of television and radio programming. While many of the available programs are advertiser-supported and are transmitted in the clear, others are encrypted and require the use of a descrambler and the payment of a monthly subscription fee for their reception.

Sports. With one 24-hour regional sports channel and over a dozen national broadcast networks with regular sporting event coverage, it is now possible to view a dazzling array of athletic competition from around the world, including live coverage of soccer, basketball, tennis, volleyball, and baseball games. There are literally hundreds of hours of sports coverage every week carried via satellite, more than enough for even the most dedicated fan. Dish owners also can watch "wild" sports feeds, transmissions by broadcasters from distant sports arenas to their respective home TV studios.

Since satellites play such a vital role in TV distribution these days, there is a reasonable chance that any major international sports event will be available to satellite dish owners via one of the international INTELSAT satellites serving the Pacific Ocean Region. INTELSAT satellites are used to relay sports events such as the Olympics and the World Cup Soccer Games to an international audience.

Movies. Asiasat's STAR Plus channel features many popular and critically-acclaimed films. The channel also offers drama, miniseries, comedy, talk shows, documentaries and other entertainment. The various national TV networks available via satellite also offer a selection of movies in the evening.

In 1992, the Japanese government approved the direct-to-home satellite transmission of two Japanese movie services. These channels, which are transmitted by the Japanese Superbird and JCSat satellites, can be received in Japan by antennas less than 1 meter (3.28 ft.) in diameter.

News and Information Channels. Asiasat's STAR TV delivers 24-hours-a-day of news provided by the BBC's World Service Television channel. CNN International also is available from regional Palapa and INTELSAT satellites. Moreover, international news services such as VIS-ASIA, WTN, and Asiavision offer daily news feeds to the region covering major international and regional events. The various national broadcast networks using satellites within the region also transmit regular daily news programs.

Some of the more interesting satellite TV news transmissions do not occur on a scheduled basis. Unedited and unexpurgated, these raw video feeds let you watch everything, not just what the networks want you to see. With a little extra effort and some patience, you can explore these occasional video (o/v) channels and view live news feeds that place you right in the middle of the action.

A new generation of transportable satellite uplinks are used by global and national news organizations to transmit live on-the-scene reports back to their main TV studios. Gaining direct access to these satellite news feeds puts you on the cutting edge of worldwide developments. Several of the INTELSAT satellites often serve as effective distribution hubs for routing overseas news feeds from broadcasters such as NHK Japan Broadcasting, Fuji TV, and the BBC either to their respective home studios or to various affiliate broadcast or cable networks in the region.

Broadcast Networks. For those rural Asians who live beyond the reach of most terrestrial TV stations, satellites provide the only effective way to receive network programming. TV networks in Thailand, Malaysia, Indonesia, the Philippines, Australia, and Japan use satellites to distribute their prime time programming to their respective affiliate stations.

General Entertainment Programming. In addition to its dedicated news and sports channels, STAR TV also offers three channels of general entertainment programming. MTV Asia, which carries the latest international pop and rock music videos, also features performances by popular Asian artists.

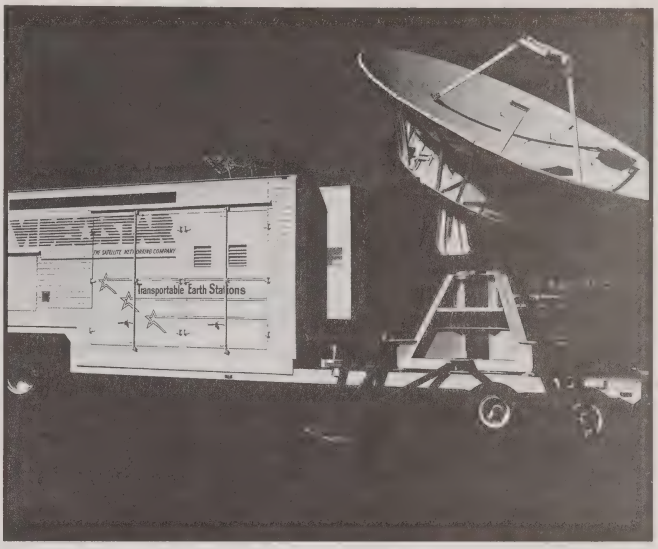


Fig.2-2. A transportable satellite uplink. (Photo by Mark Long.)

Radio Programming. In addition to their television transmissions, several satellites also deliver numerous audio services with programming that ranges from classical and top forty, to easy listening and heavy metal rock. News and talk radio services also are available.

Voice and Data Traffic. In addition to handling a fair amount of video traffic, satellites also are used to relay computer data at speeds of several million bits of information per second, send mail electronically, and carry on private telephone conversations.

Satellite Program Guides. With such an awesome array of programming available, a program guide becomes an essential tool to keep you from endlessly hopping from channel to channel. Similar to the TV listings in your local newspaper, satellite guides attempt to list the available programming on an hour-by-hour basis. They also provide readers with up-to-date Satellite Program Grids that show you the programming logs for each of the available video and audio services.

To make finding special interest programming easier the satellite program guide may break down the various offerings into individual categories such as soaps, shopping, children's, business, nature, religious, educational, and foreign language. They also can go into detail about current movie offerings, special presentations, and upcoming sporting events in each and every field.

Some of the available video and audio program services may change transponders and even satellites as time goes on; therefore, you'll need a subscription to keep abreast of the latest changes. Here's what's available:

Star Guide—a monthly magazine published in Thailand which provides program information on what's happening on Asiasat—is available from Loxley (Bangkok) Limited, 304 Suapah Road, Bangkok 10100, Thailand. Tel: 2213566-68 Telefax: (662) 2244499.

STAR TV Hotel Guide—a monthly publication for hotels which carry the STAR TV services on their in-house cable TV systems—is published on the first day of each month by All Publishing Limited, 1202 Tower I Admiralty Centre, 18 Harcourt Road, Hong Kong. Tel: (852) 865-7874. Telefax: (852) 528-6740.

As many as ninety different publications—including newspapers serving Hong Kong, Israel, Indonesia, Taiwan, Thailand, and India—also carry the program schedules for all five STAR TV channels on a regular basis.

Low-Powered C-Band Satellites

The following low-powered C-band satellites provide more than two dozen channels of news, sports, and entertainment programming. The two-digit alpha-numeric codes which follow the names of the various satellites (A1, P2, I5, etc.) correspond to remote control keypad codes many satellite receivers use for locating the individual satellites. They also may be used in satellite program guides to identify the various satellites.

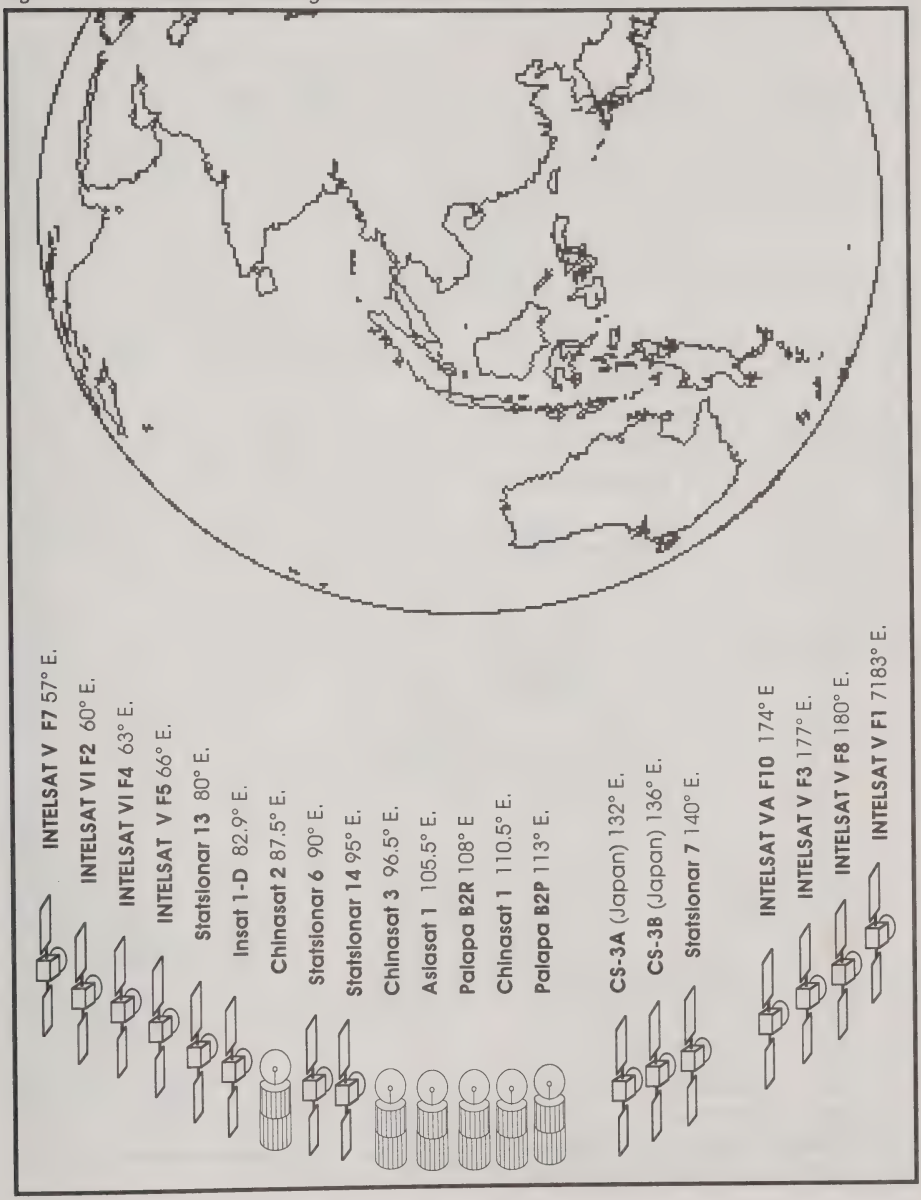
Asiasat

On April 7, 1990, Asiasat 1—the first commercial communications satellite designed for enhanced coverage of Asian countries—was launched to 105.5 degrees east longitude by the China Great Wall Industry Corporation's Long March 3 rocket. This regionally-based satellite is owned by Asia Satellite Telecommunications Co. Ltd. of Hong Kong.

Formerly known as Westar VI, Asiasat-1 initially was built by Hughes Aircraft for the American Western Union corporation. Westar VI was launched in 1984, but the satellite's payload assist module (PAM) failed to boost the spacecraft into a geostationary orbit. In 1985, a special NASA Space Shuttle mission retrieved the unused satellite and returned it to Earth. The satellite subsequently was refurbished and sold to Asiasat.

Asiasat 1 generates two regional spot beams covering most parts of Asia (see page 28). The *Northern Beam* covers China, Hong Kong, Taiwan, North and South Korea, Nepal, Bangladesh, and Japan. The *Southern Beam* covers Thailand, Pakistan, Malaysia, Myanmar, Singapore, Vietnam, Laos,

Fig.2-3. C-band satellites covering Asia and the Pacific Rim.



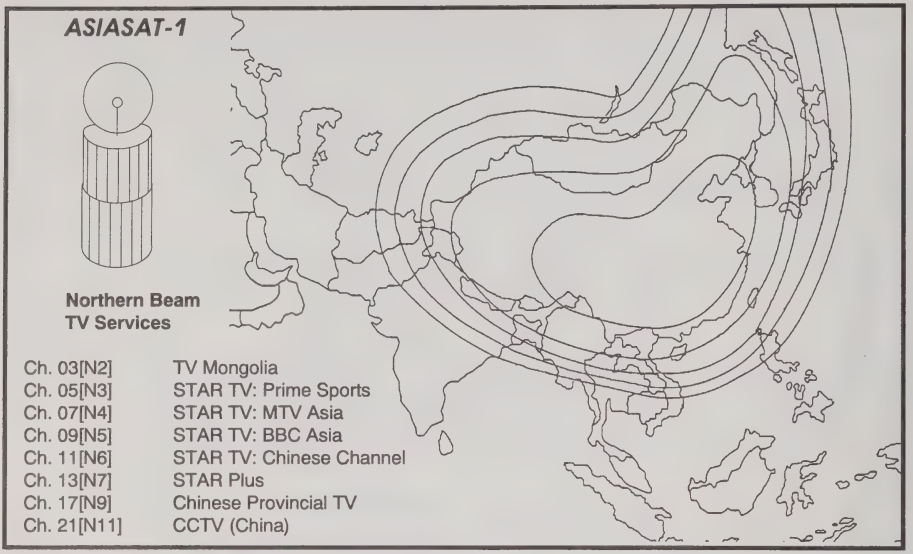


Fig.2-4. Asiasat-1 Northern Beam coverage zone.

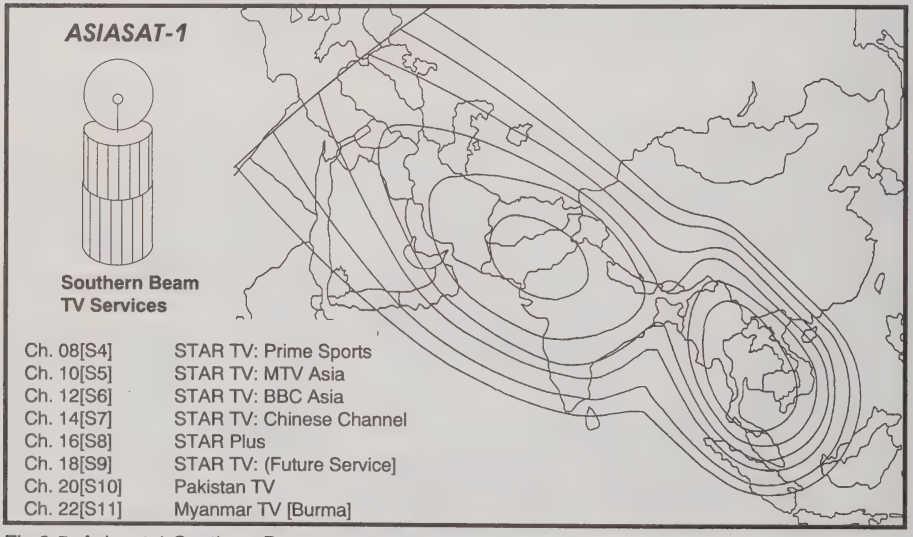


Fig.2-5. Asiasat-1 Southern Beam coverage zone.

Kampuchea, Afghanistan, Iran, Saudi Arabia, Kuwait, Egypt, and Israel.

STAR TV Program Lineup

Ten Asiasat transponders, five in each of the two beams, are used to transmit a package of direct-to-home television services known as STAR TV. All STAR TV channels air on a 24-hour-a-day basis. The STAR TV programming package includes a news service provided by the *BBC World Service Television, MTV: Music Television*, *Prime Sports*, the *Chinese Channel*, and *STAR Plus*—a general entertainment service.

All services are broadcast in stereo using the high-quality "Panda Sound System" developed by Wegener Communications, Inc. of the United States. Four of the five STAR TV services are broadcast in both English and Chinese. *The Chinese Channel,* however, is only available with a Mandarin-language sound track.

Originating from London, *BBC Asia* keeps viewers up-to-date on all world events. The service also provides extensive coverage of Asian news reports. Business developments and current affairs also are a regular part of the channel's continuous coverage.

MTV: Music Television is an Asian version of the popular American program service. This channel provides the latest music videos from such international pop stars as Madonna, Mariah Carey, Michael and Janet Jackson, and Phil Collins, as well as the performances of popular Asian musical groups. MTV also features live concerts, music news, exclusive interviews, and classic American entertainment programs such as the best of "Saturday Night Live".

Prime Sports is Asia's first 24-hour sports channel. The channel features many popular international, American, and Asian sporting events, including live satellite coverage of the U.S. Open Tennis Tournament, Ryders Cup Golf, and cricket's World Cup series.

The Chinese Channel is dedicated to airing entertainment programming for Mandarin-speaking TV viewers throughout Asia. Specially selected programs include action-packed dramas, comedies, Chinese language music videos, and special events coverage.

STAR Plus, STAR TV's entertainment channel, offers blockbuster films, miniseries, comedies, documentaries, and selected programs from popular British and American TV series.

Other Asiasat TV Services

Additional Asiasat transponders transmit the national TV services of Burma (Myanmar TV), Pakistan, the People's Republic of China (both CCTV and Chinese Provincial Television from Guizhou and Yunnan, China), and

Fig. 2-6. Asiasat-1 TV and Radio Transmission Times (in GMT).

Mongol Televiz	Monday:	None	
	Tuesday thru Friday:	10:50~14:00	GMT
	Saturday:	05:50~14:00	
	Sunday:	07:50~14:00	
MTV Asia, STAR Plus, Prime Sports, Chinese Channel			
BBC World Service TV	Monday through Sunday:	24 hours per day	
BBC World Service Radio†	Monday through Sunday:	24 hours per day	
Guizhou TV	Tuesday, Thursday, & Saturday:	02:00~06:00 & 10:00~15:00	GMT
Guizhou Radio	Tuesday, Thursday, & Saturday:	21:50~01:10 01:50~06:00 10:50~16:05	GMT
Yunnan TV	Monday, Wednesday, Friday, & Sunday:	00:30~15:30	GMT
Yunnan Radio	Monday, Wednesday, Friday, & Sunday:	00:30~15:30	GMT
Myanmar TV	Monday thru Friday:	13:15~16:15	GMT
	Saturday & Sunday:	06:30~08:30	GMT
		13:15~16:15	GMT
Pakistan TV	Daily	14:00~14:30	GMT
		16:00~16:30	GMT

† BBC World Service Radio (1): English-language service

BBC World Service Radio (2): Burmese, Bengali, Hindi, Urdu, Pashto, Persian, Arabic, Turksih, Mandarin, Indonesian, Vietnamese, Thai, Tamil, Russian, and English.

BBC World Service Radio (3): Mandarin, Cantonese, Burmese, Persian, Vietnamese, Urdu, Pashto, and English.

Mongolia (Mongol Televiz). All of the Asiasat-1 TV services mentioned above can be received by antennas ranging from 6 to 10 feet (2 to 3 meters) in diameter from locations within the central contours of the satellite's Northern and Southern Beams. (See the chart on page 186 to determine the right antenna size for your area.)

Palapa Satellites

Satellite TV viewers in Asia and portions of the South Pacific can receive TV broadcasts from Indonesia's Palapa B2P and B2R satellites. A third satellite—Palapa B4—is scheduled for launch in mid-1992. The assigned orbital positions for these satellites are 108, 113, and 118 degrees east longitude.

The full-time national TV services of Malaysia (System Televisyan Malaysia/TV3 and TV1 Malaysia), Thailand (Army TV/Channel 5 and BBTV/Channel 7 Bangkok), Indonesia (RCTI, Televisi Republic Indonesia—TVRI, and CPTI Educational Television), and the Philippines (ABS/CBN) are presently distributed by Palapa B satellites. What's more, the satellites handle international news exchanges on behalf of Asiavision and Vis-Asia. Best of all, both CNN and ESPN are currently using a Palapa B satellite to test Asian editions of their popular international news and sports services.

Fig.2-7. Palapa satellite. (Courtesy Hughes.)

Palapa B2P TV Services	Palapa B2R TV Services
RCTI Indonesia	TVRI Indonesia
TV3 (System Televisyan Malaysia)	CPTI Educational TV
CNN International	News exchange channel
ARMY TV/Channel 5, Bangkok	
BBTV/Channel 7, Bangkok	
TV1 Malaysia	
ABS-CBN Philippines	
Asiavision/Vis-Asia	
ESPN International	

Fig.2-8. Palapa TV and radio programmers (subject to change).

Chinasat Satellites

The People's Republic of China presently has three domestic communications satellites in geostationary orbit at 87.5, 96, and 110 degrees east longitude. Each of these Dongfanghong 2 (DFH-2) series satellites carries four C-band transponders. The satellites presently transmit two Chinese TV networks (CCTV 1 & 2), educational television (CETV) programs, and a regional TV service (Xizang TV) for Tibet.

Insat 1-D

India presently operates a domestic communications satellite known as Insat 1-D. This satellite, which is located at 82.9 degrees east longitude, carries twelve C-band (3.7 to 4.2 GHz) and two S-band (2.5 GHz) transponders.

The INTELSAT Satellite System

In 1965, the world's first global satellite communications system was initiated by the International Telecommunications Satellite Organization (INTELSAT). With 122 member countries, INTELSAT has become one of the world's most successful international business cooperatives. It relays a variety of telecommunications between countries, and in some instances, from one area of a country to another.

The INTELSAT system simultaneously relays thousands of telephone conversa-

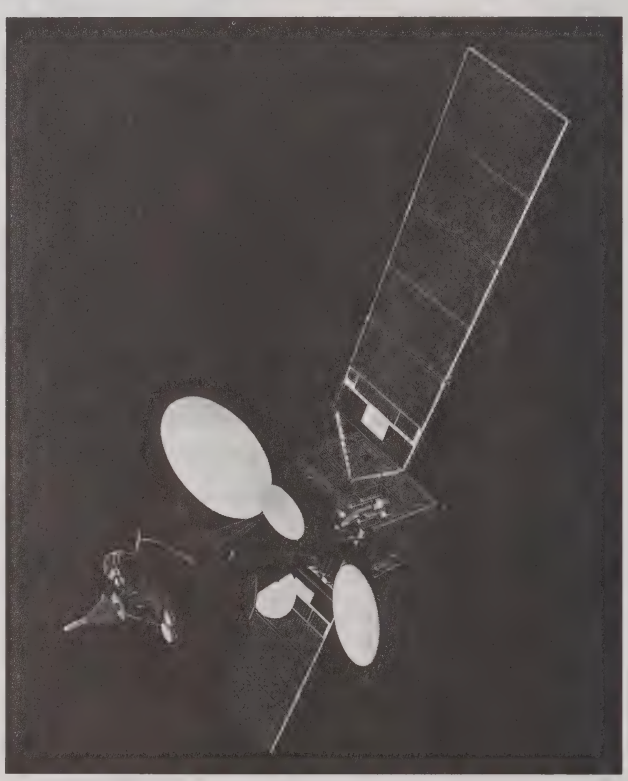


Fig. 2-09. INTELSAT V satellite. (Courtesy INTELSAT.)

tions, telegrams and telexes, and dozens of television programs. Today's INTELSAT satellites handle two-thirds of the world's overseas telephone calls and most transoceanic television.

Today, a total of fifteen INTELSAT V, V-A, and VI series satellites are in operation. In addition to the telephone and data channels made available, these satellites relay domestic TV services and provide capacity for international television exchanges.

INTELSAT also maintains several of these satellites as in-orbit spares. In the event of a satellite failure, one of these satellites can be used to reinstate regular services with a minimum amount of down-time. These spares also can be moved to other locations within the Clarke Orbit to provide new services when they are required. Capacity aboard INTELSAT's in-orbit spares is leased or purchased on a preemptible basis by various member countries to provide full-time domestic television and telephone services within their own countries.

INTELSAT regularly changes the positions of many of its satellites in order to optimize total system performance and to accommodate new countries that are leasing INTELSAT transponders for domestic and international communications use. Consequently, the satellite names which appear in the charts found elsewhere in this chapter will be continually changing.

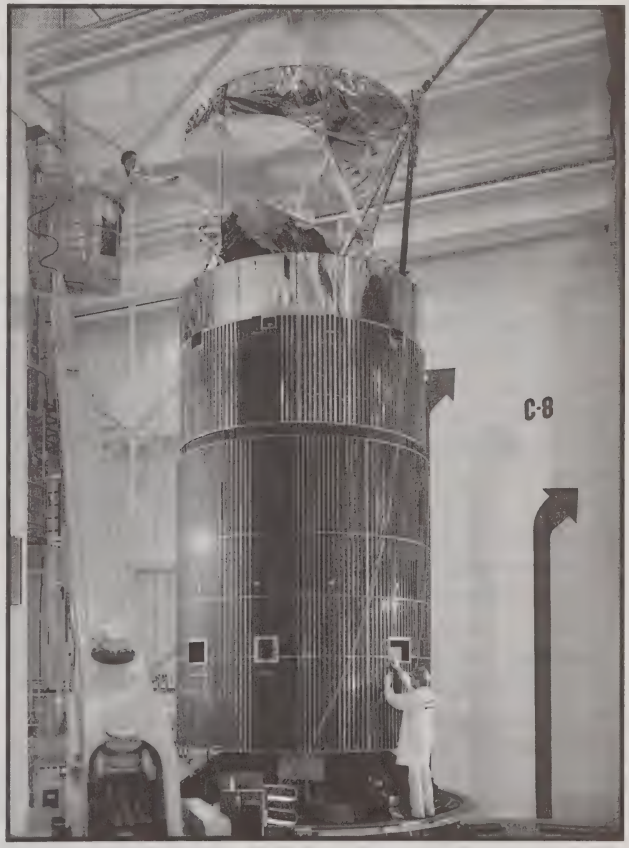


Fig.2-10. INTELSAT VI satellite. (Courtesy INTELSAT.)

As many as eight INTELSAT V, V-A, and VI series satellites can be received from locations in Asia. These satellites are positioned in clusters located over the Indian Ocean Region (IOR—57, 60, 63, and 66 degrees east longitude) and the Pacific Ocean Region (POR—174, 177, 180 and 183 degrees east longitude). INTELSAT satellites in the IOR relay the domestic TV services of Malaysia (RTM 1) and Thailand (Channels 3 and 9, Bangkok), and transmit Worldnet TV programs on behalf of the U.S. Information Agency. These satellites also transmit news and sports feeds on behalf of the world's major broadcast organizations. INTELSAT satellites in the POR are used to transmit full-time American program services such as CNN, ESPN, NBC, CNBC, and CBS to affiliate stations in Australia, New Zealand, and Asia. These satellites transmit the domestic TV services of France (RFO France/Tahiti) relay Worldnet and American Forces Radio Television (AFRTS) programs, and handle news and sports feed on behalf of the world's major broadcast organizations.

Readers should keep in mind that larger antennas (usually 5 to 67.5 meters) must be used to obtain adequate reception of INTELSAT TV services than what is normally employed to receive domestic satellites such as Asiasat and Palapa (2 to 3 meters). Most of the American TV services using the Pacific Ocean INTELSAT cluster also are encrypted to prevent unauthorized reception.

The STATSIONAR Satellite System

STATSIONAR (Russian for "stationary") is the name of Russia's global satellite system. The Gorizont (Russian for "horizon") and Raduga (Russian for "rainbow") spacecraft are the classes of STATSIONAR satellites that Russia (Commonwealth of Independent States) uses to provide the domestic relay of television, telephone, data, and radio broadcasting signals.

These satellites also are used by INTERSPUTNIK, the international satellite cooperative comprised of several east European, African, and Asian

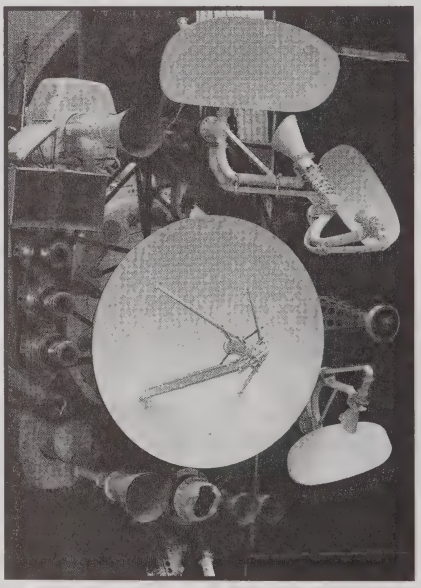


Fig.2-11. A Russian Statsionar (Gorizont) satellite.

nations. This cooperative relays TV and telephone communications between member countries, providing a service that is analogous to that of INTELSAT.

Asian satellite TV viewers can receive Russian-language television programs from the Statsionar satellites located at 80, 90, 95, and 140 degrees east longitude. In 1992, the Statsionar 13 satellite located at 80 degrees east longitude began to relay a new TV channel called *The Asian Network* which is uplinked from India. Statsionar 13 also carries daily news and sports exchanges between members of the INTERSPUTNIK organization, which includes the Asian countries of Vietnam, Mongolia, Laos, and North Korea.

Ku-band Satellites for Asia and the South Pacific

Several medium and high-powered Ku-band satellites are beaming dozens of TV signals to locations throughout Asia and the South Pacific. Because the coverage beams of the Ku-band satellites are quite concentrated, reception is limited to locations within the individual countries operating the satellites, or within bordering nations. Within their footprints, most services can be received by antennas which are less than 4 feet (1.2 meters) in diameter.

All INTELSAT and selected STATSIONAR satellites also carry Ku-band satellite transponders. However, none of these satellites carry full time TV services which can be received in the Asian or Pacific Rim regions. By and large, their use is limited to occasional exchanges of news and sports programs on behalf of international broadcast organizations.

The Superbird and JCSat Satellites (Japan)

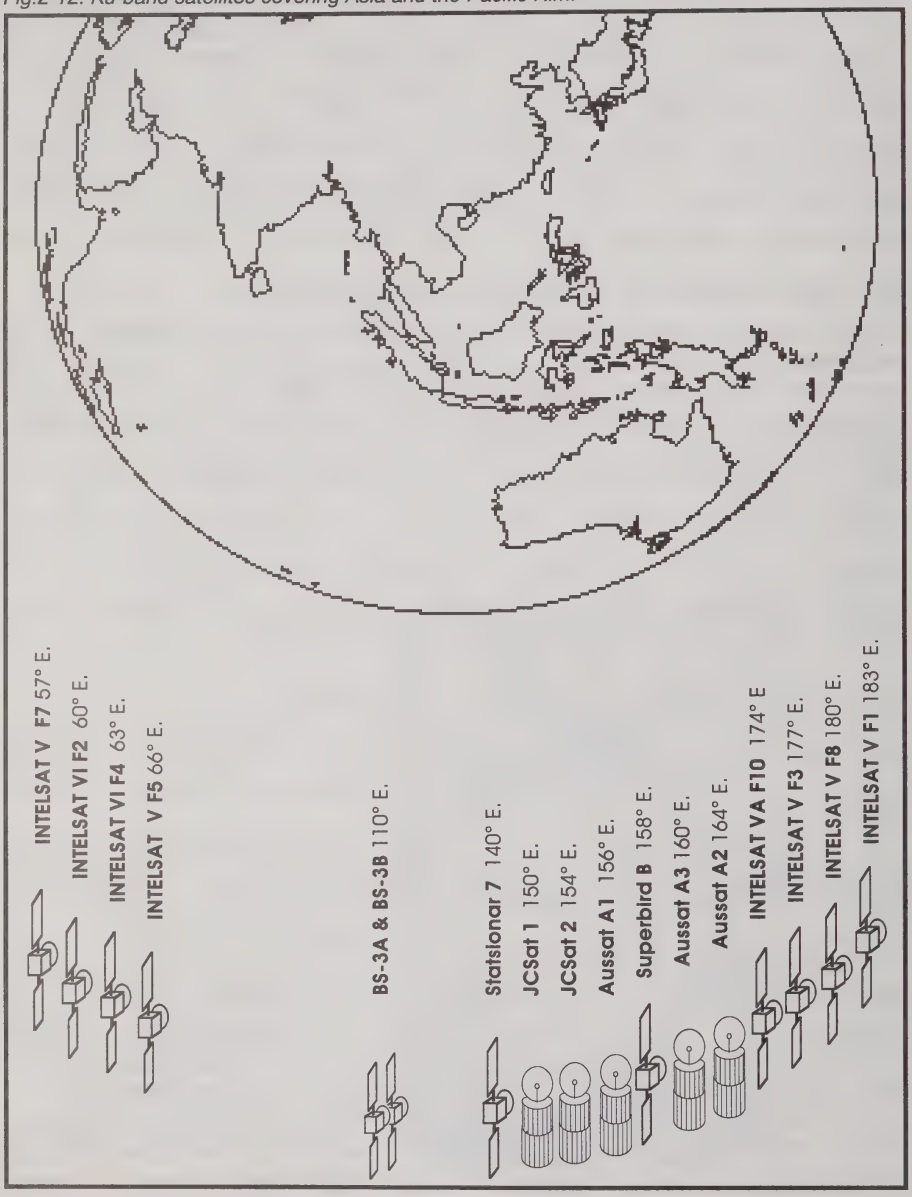
The JCSat and Superbird spacecraft are medium powered Ku-band satellites which transmit video, voice, and data signals in the 12.25 ~12.75 GHz frequency band. Both satellites use highly concentrated spot beams which limit reception to the Japanese islands.

In 1992, the government of Japan approved the use of the medium-powered Japanese JCSat and Superbird satellites for direct-to-home satellite TV broadcasting. The approval was granted because capacity on the current Japanese DBS satellites is limited to just three channels.

A total of six channels have been licensed for reception by Japanese home dish owners using antennas that are less than 1 meter (3.28 feet) in diameter. The following services will be broadcast by one of the JCSat spacecraft: *Japan Cable Television,* which will use a considerable amount of programming from CNN International; *Star Channel,* a foreign film service; and *Music Television.*

Superbird B will transmit the following services: *Japan Sports Channel,* which will include programs from ESPN; music videos from *Space Shower;* and a Japanese movie service called *Satellite Film and Drama.*

Fig.2-12. Ku-band satellites covering Asia and the Pacific Rim.



BS-3A and BS-3B DBS Satellites (Japan)

Collocated at 110 degrees east longitude, Japan's BS-3A and BS-3B spacecraft are high-powered DBS satellites that collectively broadcast three channels of TV programming into the Japanese islands using the 11.7 ~ 12.0 GHz frequency band. Reception within mainland Japan can be obtained by antennas as small as 45 cm (18 inches) in diameter.

On July 4, 1987, NHK Japan Broadcasting Corporation began transmitting a bilingual 24-hour DBS service (Satellite Channel 1) with a program format that is substantially different from NHK's two terrestrial TV services. All programs presented on Satellite Channel 1, which primarily cover world news and sports events, are exclusively for NHK's satellite service. In the world news time slot, news programs produced by major broadcasting networks in several countries are presented with minimum time differential. Economic programs reporting on the state of the global economy also are presented.

NHK has developed an automatic translating machine that translates English into Japanese. This machine is used in conjunction with the news programs coming from English-speaking countries.

Sports programs are another major feature of Satellite Channel 1. Many sports events are presented in prime time each evening. On Sundays, the entire 24 hours from the start of the day till midnight is devoted to the "Sports Special" in which sports events from the world are presented, including U.S. Major League baseball games, NFL football games, the World Cup soccer matches, boxing, and auto-racing.

On June 3, 1989, NHK expanded the coverage of Satellite Channel 2, which previously transmitted programming already offered by the terrestrial NHK TV service, to include material exclusively for satellite TV viewers. The service also expanded operations to 24-hours-a-day.

Satellite Channel 2 provides a wide range of entertainment and cultural programs with an emphasis on movies, dramas, music, and special events. About 40 percent of the programs are produced exclusively for the satellite service, with the remaining 60 percent consisting of material already broadcast terrestrially by NHK. Included is a selection of the best programs from overseas, including movies, documentaries, dramas, animation, musical events, and special performances.

In 1991, Satellite Channel 3 was activated. This channel is shared by Japan Satellite Broadcasting, a privately-owned company, and by NHK Japan Broadcasting, which transmits up to eight hours of high definition television (HDTV) programming each day using the Hi-Vision system developed by NHK Laboratories.

Aussat Satellites (Australia, New Zealand, and Papua New Guinea)

Flying north from Sydney, one cannot help but be overwhelmed by the grand scale of the world's largest island. From the Great Barrier Reef off the Queensland coast (the largest coral formation in the world) to the Great Sandy Desert in the west, Australia is an immense land that defies easy description. While over 60 percent of the Australian people are urban dwellers who live in big cities such as Sydney, Melbourne, Brisbane and Perth, several hundred thousand "Aussies" make their home in the vast wilderness known as the "Outback". In the bush country of Australia, there are Aboriginal reserves and privately-held ranches the size of whole American states.

For those who live in widely-scattered Outback settlements, the feeling of isolation can be oppressive—particularly when the mail takes several weeks to reach you, the nearest neighbor is ten or twenty miles down the road and a trip to the closest town of any consequence is an all-day excursion. Since 1986, however, miniature 3 and 4 foot dishes have been sprouting up in remote Outback towns from Booligal to Backabuggery. These tiny antennas are beginning to conquer the vast distances that were once formidable barriers to the development of Australia's interior.

On August 27, 1985, the Aussat A1 spacecraft was deployed from the cargo bay of the space shuttle "Discovery". Aussat A2 followed on November 27, 1985, when NASA's space shuttle "Atlantis" ejected the second Hughes-built spacecraft into orbit. A third Ausat satellite launched on September 15, 1987, was specially designed to provide telecommunications services on behalf of New Zealand and the Micronesian island nations as well as for Australia.

The Aussat A satellites, which transmit within the 12.25 ~ 12.75 GHz frequency band, have multiple spot beams which concentrate their signals

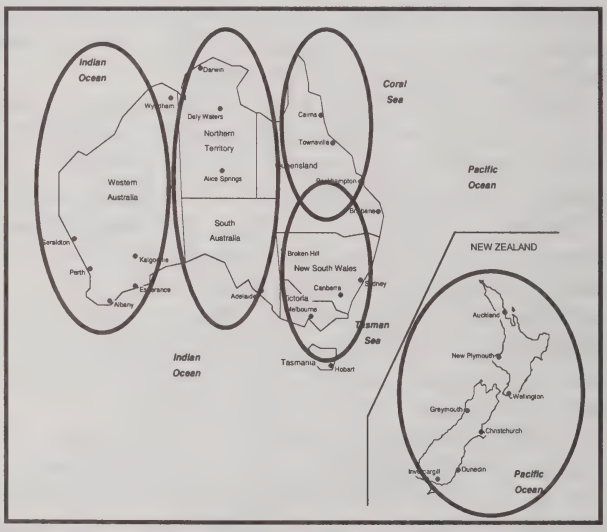


Fig.2-13. Aussat A Western, Central, Northeast, Southeast & New Zealand (A3 only) spot beams.

over selected portions of Australia, New Zealand, Papua New Guinea, and the islands of the southwest Pacific. These spot beams primarily are used to deliver the TV and radio services of the Australian Broadcasting Company (ABC)—Australia's equivalent of the BBC—to each Australian time zone, with the programming originating from the Capital City of each region. The resulting TV signals are so strong that interference-free reception can be obtained by dishes as small as three feet in diameter within their respective coverage zones.

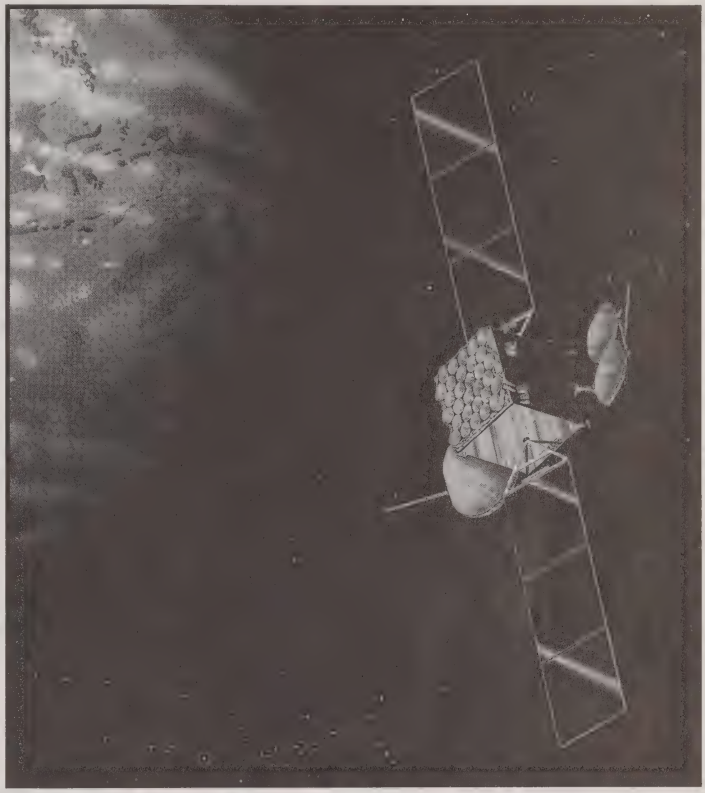


Fig. 2-14. The first Aussat B satellite was successfully launched in 1992. (Courtesy Hughes Aircraft.)

ABC's Homestead and Community Broadcasting Satellite Service (HACBSS—pronounced "hack-bus") has been joined by the Remote Community Television Services (RCTS—pronounced "R-C-T-S"). Regional television programmers such as *Golden West*, *Queensland Satellite TV*, and *Imparja* provide TV programming to their respective areas of Australia.

In 1992, the Australian government approved the licensing of pay TV services for Australia. Several new satellite subscription services will be transmitted by the next generation Aussat B satellites, the first of which was successfully launched in 1992. Aussat B satellites will replace the older Aussat A satellites beginning in 1993.

The Future of Satellite TV in Asia and the South Pacific

Numerous TV and radio channels already are available via satellite. Moreover, when major news or sports events occur, the number of active channels on satellites covering Asia and the Pacific Rim countries increases substantially.

By the middle of the decade, a new generation of both domestic and international satellites will begin serving the region, providing capacity for dozens of new satellite TV and radio channels. For example, domestic satellites for Japan, Malaysia, South Korea, and Thailand already are under development with launch dates reserved for 1994 and 1995.

On the international front, INTELSAT intends to introduce a new series of INTELSAT VII satellites beginning in 1994. These satellites have been expressly designed to provide dedicated services for Pacific Rim countries. Private international satellite operators such as Alpha Lyracom, Columbia Communications, Pacific Satellite, Pacstar, and Unicom also have plans of their own to operate satellites which will serve the growing communications marketplace in Asia.

Later in this book, we will provide you with more details on how all of these new domestic and international satellite systems will function and how their introduction could affect your future viewing options. But one thing's for sure: Satellite TV is fast becoming an attractive and affordable entertainment option for millions of individuals living in Asia and the South Pacific. What's more, the best is yet to come!

Chapter 3
Understanding Your Satellite TV System

Now that we've taken a look at the satellites and the programming that's up there, it's time to come back down to Earth and check out just what it takes to receive them. You do not have to understand the technical details of this chapter to enjoy your system. It's similar to operating your regular TV set: you don't have to know anything about the antenna or cable. It can be as simple as pushing a button corresponding to your favorite channel. But you may appreciate a simplified yet comprehensive overview of the internal workings of your system.

First of all, let's take a look at a block diagram of the overall system.

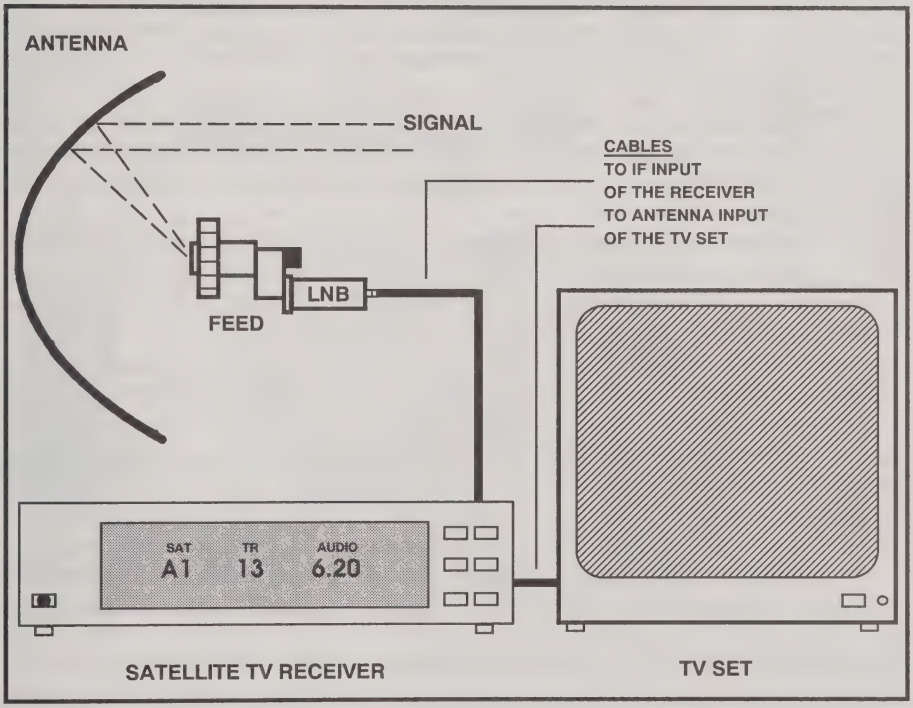


Fig.3-1. Satellite TV System Block diagram.

The Antenna

The 4-GHz microwaves transmitted by the C-band satellites are very weak in strength when they finally fall into your backyard. The large dish antenna, typically 6 to 12 feet in diameter, captures as much signal as possible and reflects it to a common point above the center of the dish, called the focal point. The dish antenna must be accurately pointed at the satellite in order to gather enough signal to make a picture appear on your TV screen. Being off by more than an inch or two can make the difference between a good picture or no picture at all. A metal device called the feedhorn is located at the focal point and helps to gather up the reflected microwave signals, conducting them back to the first stage of electronics with a minimal amount of signal loss.

The LNB

The first stage of electronics is called the low noise block downconverter or LNB. It looks like a metal box with a rectangular opening in the front of it. Centered within this opening is a short metal probe less than an inch in length. This probe is the actual satellite receiving antenna which picks up the signal that's reflected off the dish and conducts it to the first electronic circuit of the LNB.

The LNB consists of two distinct stages. The LNB's initial stage is comprised of several microwave amplifier circuits, one right after the other. They multiply the incoming microwave signal of less than a millionth of a volt by a factor of 1,000,000.

This amplified satellite signal is then sent on to the second stage of the LNB called the downconverter. The downconverter is a specialized electronic circuit which reduces the incoming microwave signal to a much lower frequency range, called the intermediate frequency, or "IF".

A microwave mixing circuit inside the downconverter combines the incoming satellite signal with a second signal generated by the LNB's dielectric resonant oscillator (DRO). Dielectric materials such as teflon or ceramics are used since their physical characteristics cause the circuit in which they are present to resonate at a precise frequency. The DRO is also pretty stable; this keeps your downconverter from drifting off frequency.

The DRO circuit is called an oscillator because it electronically vibrates back and forth to produce a microwave signal. When the incoming and DRO signals are beaten or "heterodyned" together, a signal is created that steps the entire C or Ku satellite frequency bands down to a wide block of IF frequencies ranging from 950 to 1450 MHz (or 950 to 1750 MHz for models which also are sold in Europe). This block IF signal is then filtered and amplified before being sent to the indoor receiver via a length of coaxial cable.

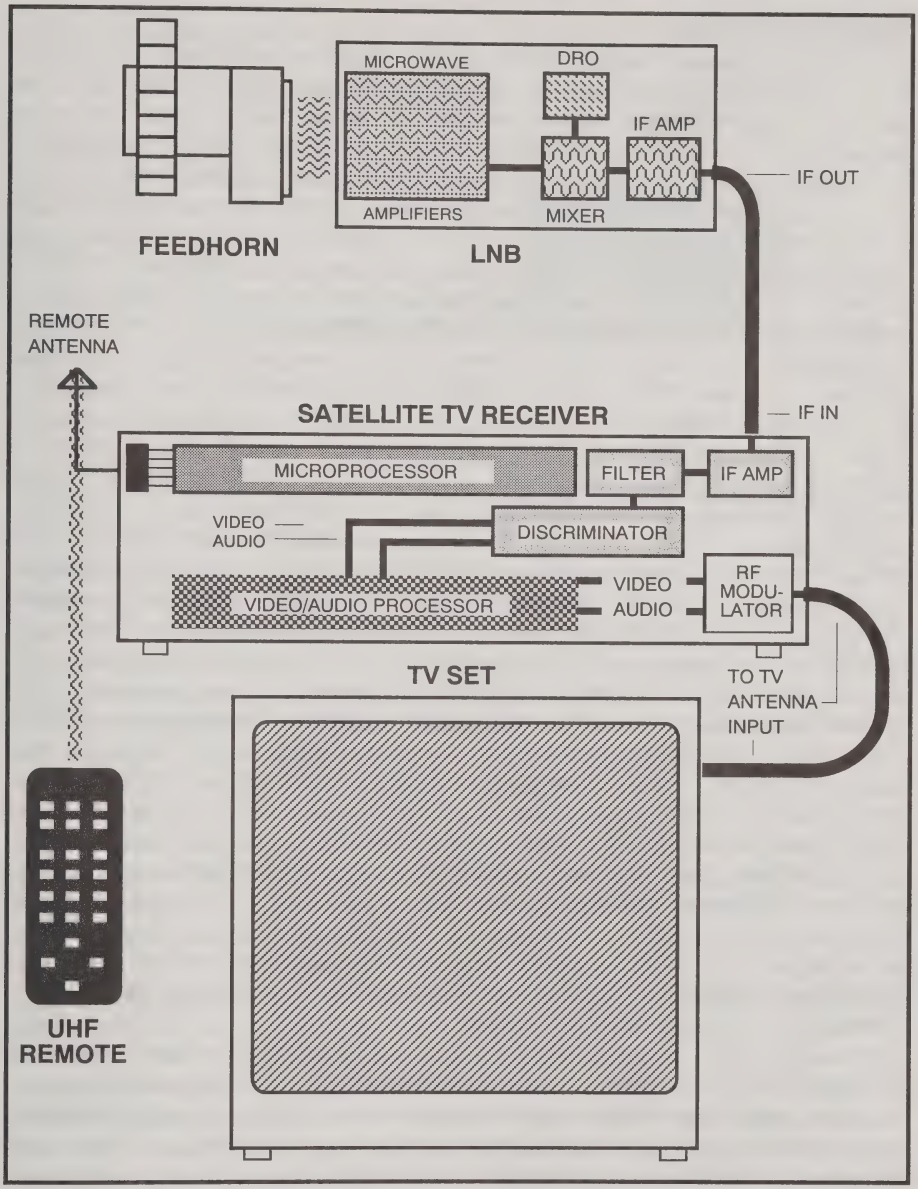


Fig.3-2. Transformation of signal through the system.

Satellite Receivers

Inside the receiver, another mixer circuit, which is controlled by the unit's channel selector, is used to produce a second IF signal that contains a single satellite channel. When we say second IF, we actually mean a band of frequencies centered on a particular frequency. Some manufacturers use a 70-MHz center frequency for their second IF signals, while others may use 130-, 140-, or even 510-MHz. Most receivers provide external loopthrough connections to the second IF portion of the circuitry so that filters can be added to enhance reception or suppress terrestrial interference.

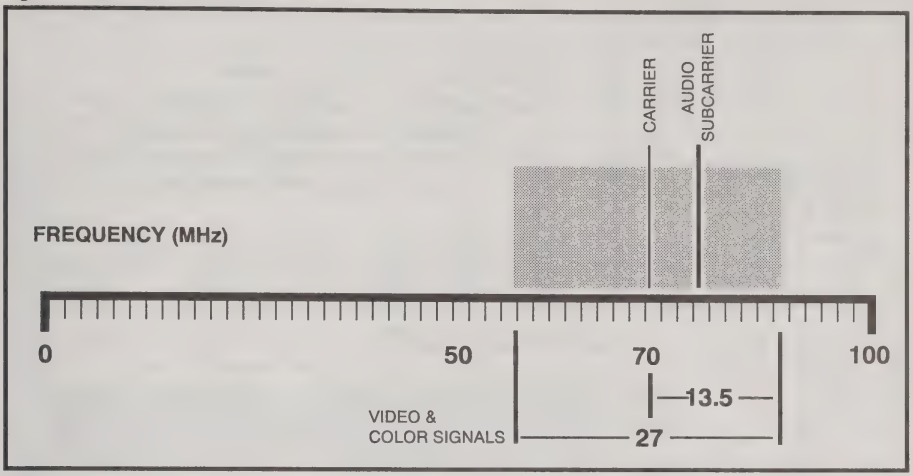
The bandwidth of the second IF signal needs to be around 27 MHz wide in order to effectively pass along the color, picture, and sound information for one satellite TV channel. The receiver takes the second IF signal, amplifies it some more and filters it down to the 27-MHz-wide signal. Unwanted background noise which is present above and below the signal is eliminated.

After being filtered, the IF signal is fed into another circuit called a discriminator. The discriminator's job is to strip off the video and audio signals, which are contained in the second IF in the same way as they were in the original C- or Ku-band signal. We may have stepped the frequency way down in order to handle it more easily, but that doesn't affect the video or audio information at all. For this reason, the original 4-GHz frequency is called a "carrier". After leaving the discriminator, the composite audio and video signals are separated and passed on to other circuits for processing.

Nearly every unscrambled satellite TV transmission uses a second carrier, called a "subcarrier", that is contained within the 27-MHz signal bandwidth. Subcarriers are used to carry the audio for each video program. The monaural subcarriers used by Asiasat are located 6.2 MHz or 6.8 MHz to one side of the center frequency. All satellite TV receivers have a control that allows you to select the appropriate subcarriers for the desired channels. On some satellites there also may be several "auxiliary" subcarriers attached to any one TV channel. Additional subcarriers are used to transmit broadcast radio programs or data transmissions. They do not interfere at all with the video program and offer a way to provide multiple use for these expensive satellite transponders. These additional auxiliary programs also can be received by your satellite TV receiver.

All receivers have a means of selecting which channel you want to see. Most of today's satellite receivers come with a wireless remote control for channel selection. Many models also provide an on-screen graphics display that will tell you which satellite channel you are viewing. Other channel selection features include channel up/down, direct access, scan tuning, designated "favorite" video and audio channels, and automatic fine-tuning.

Fig.3-3. Bandwidth.



Descramblers and IRDs

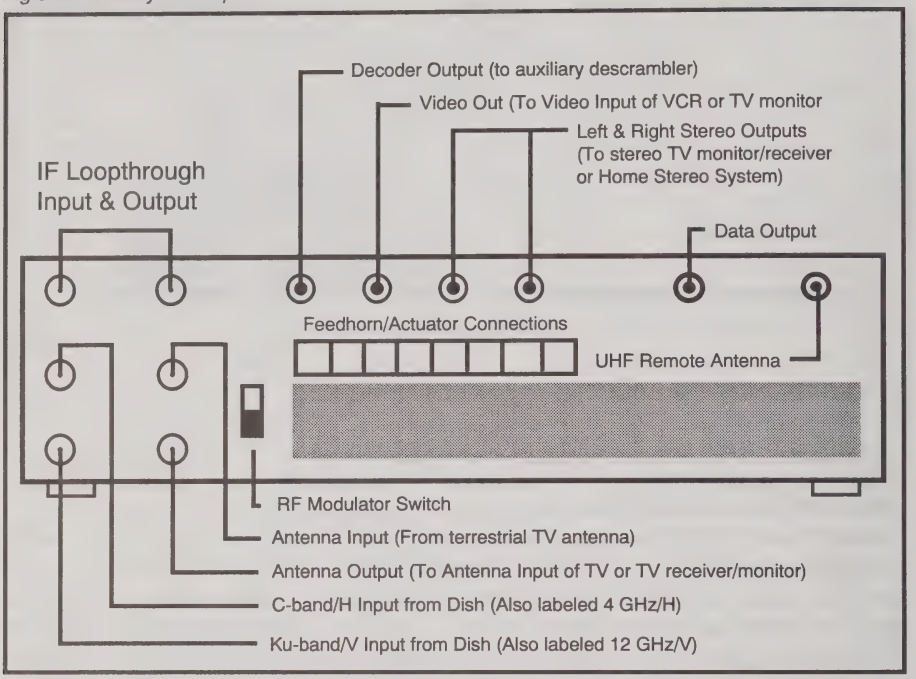
Satellite receivers come in a variety of packages that range from simple utilitarian models to infinitely more complex units that integrate the receiver, descrambler, and antenna positioner into a single integrated receiver/descrambler or "IRD". If your system is equipped with a simple utilitarian receiver, you can add a separate descrambler to gain access to subscription program services. IRDs come with a built-in descrambler module which eliminates the need for a separate descrambler box.

Scrambling is an electronic means of rendering the video and audio reception of a program unintelligible except to those stations which can reassemble the signals; all other stations intercepting the scrambled program will encounter distorted video and no audio, or in some cases, a "barker channel" that provides an audio message about how to subscribe to the scrambled program service.

The picture commonly is secured by converting the video's standard synchronization codes to an alternate format and by distorting the video in some way. One method, for example, turns the picture inside out—thereby creating a kind of negative image.

Certain encryption systems enhance their security by slicing the video into individual blocks and then rearranging the order of these blocks. A kind of electronic "key" called an algorithm is used to control the rearrangement of the block order. Unless the descrambler has access to this key, the picture remains an unintelligible jumble.

Fig.3-4. Auxiliary Hookups.



The sound portion of the programming commonly is changed from an analog waveform to a stream of digital impulses called "bits". This conversion to digital actually improves the fidelity of the audio signals. The audio also is encrypted using an algorithm.

Scrambled program services can individually address each subscriber through the use of an authorization code that is transmitted at regular intervals over their respective satellite transponders to every home satellite TV system. This code is used to switch on-or-off each descrambler module's access to the electronic keys needed before the descrambler can unlock the signal and begin to separately reassemble the video and audio signals of each program service it has authorization for. Since every subscriber's descrambler can be turned on or off within minutes, this addressable technology also makes it possible for some programmers to offer special pay-per-view and pay-per-series programs. In this case, the addressable code is switched on at the beginning of the program and then switched off again at the end of the program.

The RF Modulator

The video and audio signals are internally connected to an additional unit called the Radio Frequency (RF) modulator. The modulator acts as a miniature transmitter for a selected regular TV channel and hooks up directly to your TV's cable input, if it has one, or through a CATV transformer to your TV's antenna terminals. After selecting one of these for your satellite channel, you will still be able to receive your local broadcasts on their usual channels.

The satellite receiver also will furnish video and right and left audio outputs. These are useful for connecting directly to a VCR, stereo capable TV set, or color video monitor. Whenever high fidelity or stereo audio reception is desired, the audio outputs can be connected to your home entertainment sound center.

Most satellite-delivered entertainment services offer their programs in stereo. Encrypted services can offer digital, compact disc quality stereo. Movie services also may provide a surround sound track.

Some video perfectionists use a professional color video monitor in place of the standard television set in order to receive studio quality reception. But if you are receiving a good signal from the satellite, most modulators will give you good reception on your home television set.

Fig.3-5. TV monitor/receiver. (Courtesy Philips.)

"Basil's been working on his tan again...and tonight it's World Cup soccer. Ever since he got the dish they've been inseparable."

Chapter 4
Satellite Antennas

During the past ten years, millions of satellite antennas have sprouted up all over the globe. Most individuals, at one time or another, have probably come across one of those giant 8- to 16-foot dishes, either in a neighbor's backyard or perhaps on the roof of a local hotel or bar. You may ask yourself: "Why does that thing have to be so big?"

Typically, satellites operating in the 3.7 to 4.2 GHz frequency band only transmit from 8 to 16 watts of power. After traveling over 22,000 miles and being spread out over most of the Asian continent, the satellite signals are extremely weak, almost nonexistent. The satellite companies use low power levels because the terrestrial microwave link-up which many PTTs use to criss-cross the continent operates on the same frequency band. Higher power levels would cause interference to those telephone circuits upon which we all depend.

The international INTELSAT organization as well as countries such as Japan and Australia use medium-powered Ku-band satellites to communicate within the region. When used for television purposes, these Ku-band birds can supply dishes 3 to 6 feet in diameter with excellent reception. The reason that smaller antennas can be used to receive Ku-band signals is that these medium-powered satellites transmit from 20 to 50 watts of power.

Japanese direct broadcast satellites (DBS) operate within the 11.7 to 12.0 GHz frequency band. These high-powered Ku-band satellites, which transmit using 100 watts of power per channel, can be received by tiny 18-inch antennas.

Aluminum, Fiberglass, and Mesh Dishes

Any satellite receiving antenna catches the satellite's signal and reflects it back to a common point, called the focal point, thus taking a weak signal which is spread over a wide area and concentrating it, making it stronger. Whether made of aluminum, fiberglass, or mesh, the performance of any type of antenna is primarily governed by the accuracy of the dish's curvature. Dishes made from any of these materials can provide equally good reception for a given size. No matter what materials are used, the dish is only as accurate as the mold and dies used to produce it. For this you will have to depend on the reputation of the manufacturer.

Fig.4-1. Satellite antenna farm (Right).

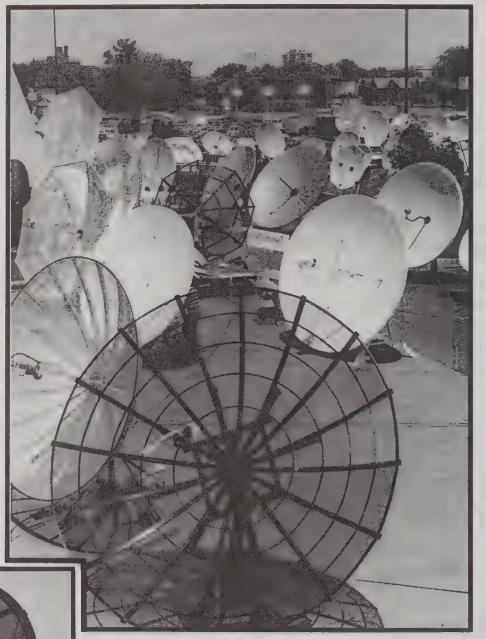


Fig.4-2. 7.5 ft. antenna with quad feed support. (Left—Courtesy Winegard.)

Solid aluminum dishes are rugged and tend to hold their exact shape over the lifetime of the system—better than fiberglass or mesh dishes. Aluminum antennas usually are coated with a special non-reflective paint to keep sunlight from being reflected to the focal point where it could damage the LNB. This type of antenna usually is constructed from marine-grade aluminum which prevents corrosion. A solid antenna with a bunch of holes drilled into it to lessen its environmental impact is called a perforated antenna.

Expanded aluminum mesh antennas currently are the most popular, possibly because they have the least impact environmentally. Since you can see through them, they stand the least chance of drawing complaints from neighbors in crowded suburban areas. Mesh dishes are perhaps the most susceptible to damage from the elements. A careful inspection of the method used for fastening the screen to the support members is advisable. You can check a mesh dish for curvature inaccuracies by running your hand across its surface. Noticeable bumps or waves in the surface indicate deviation from the precise parabolic curve necessary for good performance.

Fiberglass dishes, if well constructed, can be as good as the solid aluminum type and should work fine in your backyard or on your roof. Most standard fiberglass dish antennas have a wire mesh embedded inside of them for reflecting the satellite signal. Without a metal reflector, the satellite microwave signals would pass straight through the fiberglass. The best fiberglass dishes are pressure-molded from fiberglass-reinforced plastic. More commonly, the fiberglass is sprayed onto the mold. Fiberglass dishes may be susceptible to warpage after being exposed to the elements over the lifetime of the system. This can degrade the performance of the antenna. High-quality fiberglass antennas minimize warpage by using a mounting structure that supports a large portion of the dish's surface area.

Warpage can be detected by standing to the side and looking across the surface of the dish. The outside edges should line up with each other. Also any two strings that run from outside edge to outside edge should touch where they cross, near the center of the dish.

Dishes can come in a single piece, or as several petals that bolt together. The one-piece dish conforms most accurately to the manufacturer's master mold, but is a problem to ship. The petal dishes are stronger, easier to transport, and one or more petals can be replaced if damaged. When examining any dish you should look at how the various petals fit together. Does the surface look continuous, with little variation from petal to petal? Keep in mind that variations in curvature of as little as a quarter of an inch can affect the performance of your system.

Parabolic and Spherical Antennas

There are two main kinds of TVRO receiving antennas: the parabolic and the spherical. The parabolic dish is named after the curve that causes all the signal received to bounce into a central focal point above the antenna. The more accurate the curve, the greater the amount of signal delivered to the first electronic amplifier stage of your LNB.

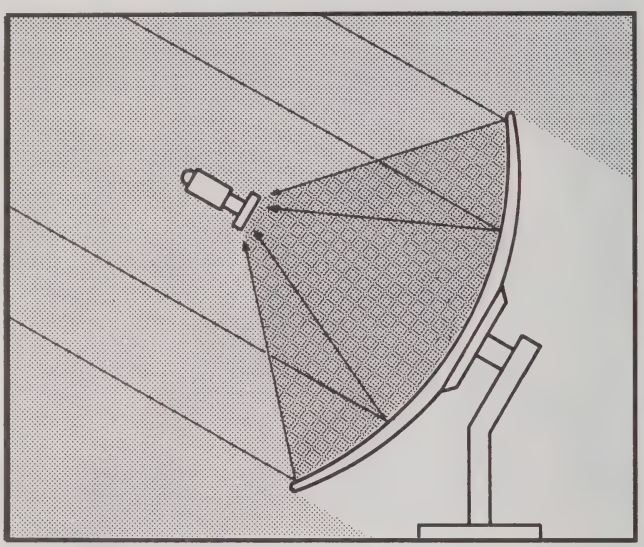


Fig.4-3. Parabolic reception.

The outer parameter of a parabolic antenna is usually (but not always) circular in shape. It must be pointed directly at the desired satellite for reception. Parabolic dishes can be manually or electrically adjusted for reception of any satellite in view from your location. The feedhorn and LNB assembly mount directly above the parabolic dish, centered at the focal point of the parabolic curve for maximum signal pickup.

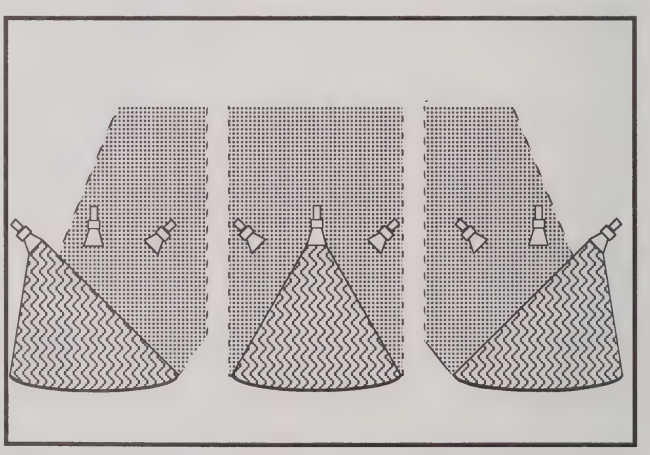


Fig.4-4. Spherical reception.

The perimeter of a spherical antenna is usually square or rectangular in shape. The spherical an-

tenna has a curvature which, if extended outward, would become a sphere. Unlike a parabolic dish with its single, well-defined focal point, the spherical antenna has a separate focal point for each satellite.

While the spherical antenna remains in a fixed position following installation, it can simultaneously see a large section of the available Clarke Orbit. The feedhorn/LNB assembly is mounted on an adjustable support that sits in front of the antenna. By moving the feedhorn and LNB to different focal points, satellites can be received if they are within about 20 degrees of the direction in which the antenna is pointed.

Antenna Gain

The performance of a dish antenna is most commonly rated in terms of gain, a measurement of the amplification that a dish gives to the received signal. Quite simply put, the bigger the dish, the larger the capture area and the higher the gain. Gain is expressed in deciBels, or dB.

Dish gain measurements are made in reference to a standard isotropic antenna. This is an imaginary aerial conceived by engineers which receives signals equally from all directions at once and has a gain of 0 dB. Real-life antennas are measured by determining how many times better they are than the isotropic standard.

The curvature of the dish acts much like a lens to concentrate the signal within a narrow corridor, called the "boresight". This area lies directly to the front and center of the antenna and is obtained through maximizing the signal present in the boresight, while limiting signals or noise coming from other directions. The amount of signal delivered by the dish is critical since the LNB can only amplify as much signal as it receives.

> 3 dB = a doubling of power; 10 dB = x 10; 20 dB = x 100
> 30 dB = x 1,000; 40 dB = x 10,000; 50 dB = x 100,000.

The following chart provides a list of typical gain figures for a variety of dish sizes. Sometimes manufacturers obtain slightly higher gain figures by improving the dish's efficiency, either through the use of tighter curvature tolerances or alternate feed techniques. From this chart we also can see that the gain of the antenna varies according to the frequency being received.

Fig.4-5. Dish Size Versus Gain Chart

Size in ft.	Size in m.	C-Band (3.7~4.2 GHz) Efficiency (%) 55%	70%	Ku-Band (11.7~12.2 GHz) Efficiency (%) 55%	70%
1	0.30	19.4†	20.5	29.0	30.1
2	0.61	25.4	26.5	35.1	36.1
3	0.91	29.0	30.0	38.6	39.6
4	1.22	31.5	32.5	40.7	42.1
5	1.52	33.4	34.4	43.0	44.1
7	2.13	35.0	36.0	44.6	45.6
8	2.43	37.5	38.5	47.1	48.1
9	2.74	38.5	39.5	48.1	49.2
10	3.05	39.4	40.5	49.0	50.1
11	3.35	40.2	41.3	49.9	50.9
12	3.65	41.0	42.0	50.6	51.7
13	3.96	41.7	42.7	51.3	52.4
16	4.87	43.5	44.5	53.1	54.1
20	6.09	45.4	46.5	55.1	56.1
25	7.62	47.4	48.4	57.0	58.0
33	10.05	49.8	50.8	59.4	60.4

† in dBi —gain in decibels referenced to an isotropic antenna.

Deep Versus Shallow Dish Design

Depending on the parabolic curvature selected by the antenna designer, the depth of any dish can vary between extremely shallow to very deep. A shallow dish will have a very long focal distance, so the feedhorn and LNB will sit out quite a distance from the center of the antenna. The shallow dish design maximizes the potential gain of the antenna, since the feedhorn has an excellent view of the entire surface area from its lofty perch.

There are certain disadvantages to a shallow dish design, however. The molecular motion of the earth itself generates a random noise pattern within the same band of frequencies used by the satellites. This noise can combine with incoming satellite signals and degrade their reception. The shallow parabolic antenna will intercept more of this noise when it is positioned at low elevation angles than a deeper dish would. The long focal length required

by a shallow dish design positions the feedhorn far above the antenna; this minimizes the potential shielding effect provided by the metal surface of the dish. An earth station using a shallow dish will be particularly vulnerable to interference created by PTT-owned microwave relay stations. This can be a consideration when the earth station is to be located in an urban environment where the possibility of encountering terrestrial interference is quite high.

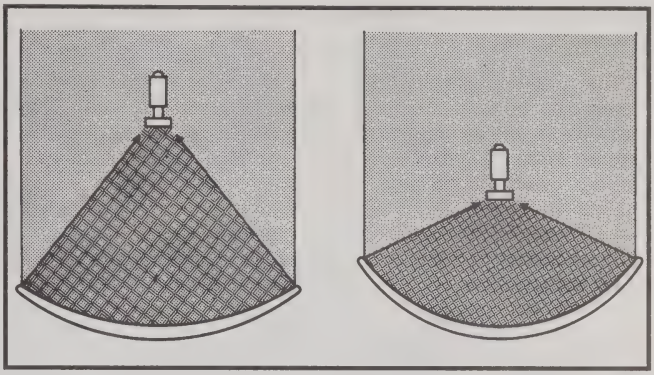


Fig.4-6. Shallow versus deep dish designs.

With a deep dish design, the LNB and feedhorn are positioned at a level almost parallel with the rim of the antenna. The deep dish provides superior shielding for the feedhorn and LNB, rejecting more Earth noise and terrestrial interference than a shallow antenna could. But because of the feed's close proximity to the surface of the antenna, it cannot view the entire surface as well as when a shallow parabolic design is used. Consequently, the deep dish will introduce less noise into the LNB, but not provide as much gain as that produced by a shallow antenna of the same diameter.

The f/D Ratio

The relative depth or shallowness of any antenna is often expressed as the focal length to diameter (f/D) ratio of the dish. Deep dishes have an f/D of .25 to .35, while the f/D of shallow dishes will range between .4 and .5. Most antenna manufacturers use the middle range of .36 to .375 f/D. If you know what the f/D of the antenna is, you can determine the correct focal length—the distance between the mouth of the feedhorn and the center of the surface of the dish—by multiplying the diameter of the antenna by its f/D ratio.

The smallest dish that could be used for receiving some C-band video transponders would be 4 feet in diameter. It would only function in the hottest signal area of any satellite's footprint in combination with a very good LNB. Even then, sparkle-free reception would only be possible on the strongest satellite transponders. We have seen effective demonstrations of this in Thailand. A city or apartment dweller might consider this option. But

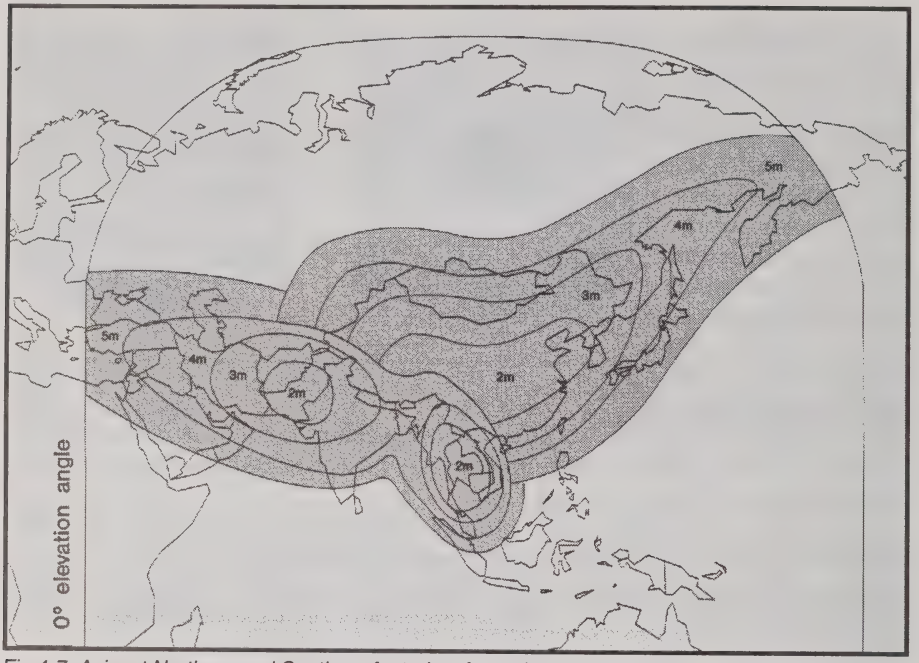


Fig.4-7. Asiasat Northern and Southern footprints for various antenna sizes. (Courtesy Asiasat.)

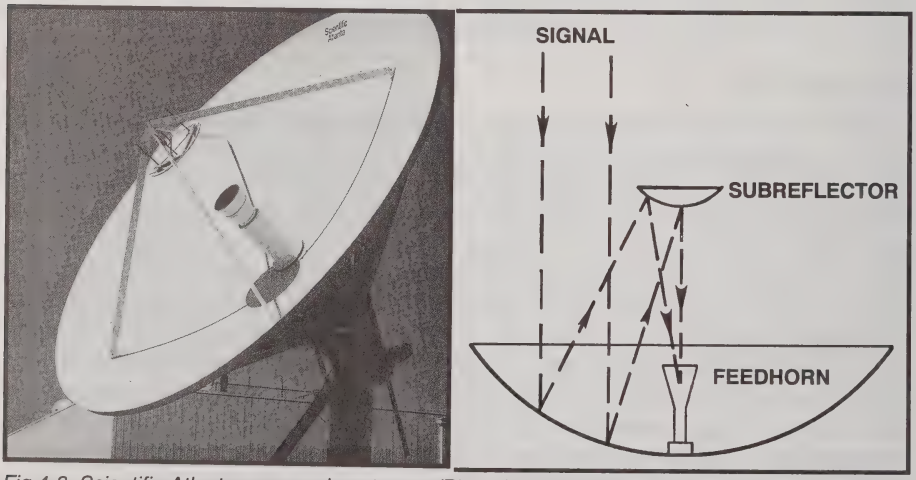


Fig.4-8. Scientific-Atlanta cassegrain antenna. (Photo by Mark Long.)

a six to eight-foot dish is a good rock-bottom minimum, depending on your location. The satellite signal gets progressively weaker for locations further away from the center of the footprint. Out on the edges the larger, higher gain antennas must be used to obtain the same results.

For locations within the Asian continent, the footprint map (page 56) illustrates the minimum recommended dish sizes for sparkle-free brilliant reception of the Asiasat 1 satellite within view of your location. Satellite effective isotropic radiated power (EIRP) levels usually expressed in deciBels above one watt of power (dBW) already have been translated into dish sizes. A margin factor has been added to allow for decreased power levels as the satellite becomes older.

If you plan on viewing more than just the Asiasat satellite, if you must use a small dish because of space limitations, or if you live in a fringe reception area, use the footprint maps and tables which appear in the back of the book to calculate the right antenna size for your location.

Prime Focus and Cassegrain Antennas

Most feedhorn/LNB assemblies on parabolic antennas are supported by the *prime focus* method, which uses a multi-legged support bracket that bolts onto the surface of the dish; this support bracket positions the assembly over the center of the dish at the required distance for maximum concentration of signal. A sturdy support structure is important here, since being off an inch or more can be critical. Another type of prime focus antenna is the buttonhook, which uses only one support member to position the LNB and feedhorn.

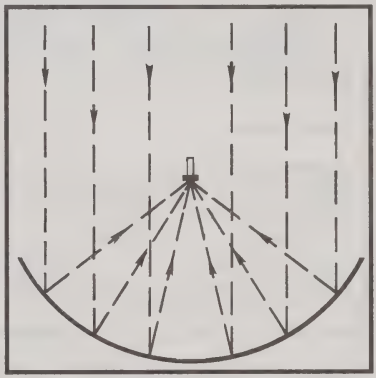


Fig.4-9.Prime focus antenna.

Cassegrain antennas are used by many commercial satellite uplinkers and downlinkers. These antennas use a subreflector mounted at the focal point. The subreflector takes the concentrated signal and sends it to the LNB, which is located at the center of the dish. For larger dish sizes, the cassegrain feed can offer a slight gain (.5 to 1dB) in overall efficiency. Cassegrain designs must cap the feed to prevent moisture from entering the LNB since it is set down in the dish rather than up above it. The main disadvantage to a cassegrain feed is that the antenna is more susceptible to interference from satellites adjacent to the one you are looking at. The subreflector must be precisely aligned to eliminate interference from the next satellite's signal.

Dish Specifications

Let's take a look at some typical dish specifications that you might encounter when evaluating particular antennas for your home system:

Construction: 4 piece preassembled, 12 aluminum ribs, Ku-band mesh, powder coat finish

Diameter (in feet/meters): 10 ft/3m

Frequency Range: 3.7 to 4.2 GHz (Asiasat, Palapa, & INTELSAT V)
11.7 to 12.0 GHz (BS-3A & BS-3B)
12.25 to 12.75 GHz (Aussat & JCSat).

Antennas Gain in DB
at 4 GHz: 40.5 dB at 70% efficiency
at 12 GHz: 49 dB at 55% efficiency
(The gain of any antenna will vary slightly depending on the frequency: the higher the frequency, the higher the gain.)

Feed: Prime focus, quad support

f/D Ratio: .375
(Focal length to antenna diameter ratio.)

Focal Point: 45"

Side Lobes: 20dB down

Operational Winds: 60 mph
(How high a wind speed the dish can operate under without significant picture degradation.)

Survival Winds: 120 mph
(The speed beyond which damage to the dish will be likely to occur.)

Mount: Horizon to Horizon Polar

Azimuth Tracking Range: 180° Azimuth adjust

Elevation Adjust: 5° to 90°
(The dish can be pointed at any satellite that lies within these elevations at your location.

Pole Size Required: 3.5" O.D.

Shipping weight: 160 lbs.

Offset-fed Antennas

Many DBS satellite installations use alternate antenna designs such as this offset fed dish which creates a focal point that lies below the center of the reflector. Superior antenna gain and sidelobe rejection is produced by keeping the LNB and feed from "shadowing" the small dish.

Fig.4-10. An offset-fed antenna. (Courtesy Primestar.)

Antenna Side Lobe Rejection

The perfect parabolic antenna would only amplify the satellite that lies directly to the front and center of the dish, while totally rejecting signals coming from all other directions. In reality, every parabolic antenna has its own unique receiving pattern which illustrates how much gain will be given to signals emanating from any direction. When a manufacturer specifies the gain of his antenna he is referring to the amplification provided by the " main lobe" of the receiving pattern which lies to the front and center of the dish. However, all antenna have "side lobes" which can amplify signals that are several degrees to either side of the main lobe. The gain of these side lobes must be kept a minimum of -15 dB below that of the main lobe. Otherwise, the signals from an adjacent satellite could cause noticeable interference to some of the program services that you'll want to view.

With 3 degree spacing between satellites becoming more and more common in the region, the problem of side lobe rejection has become a very important consideration. Small dishes commonly have their first side lobe fall at 3 degrees to either side of the main lobe, which is just where the satellite

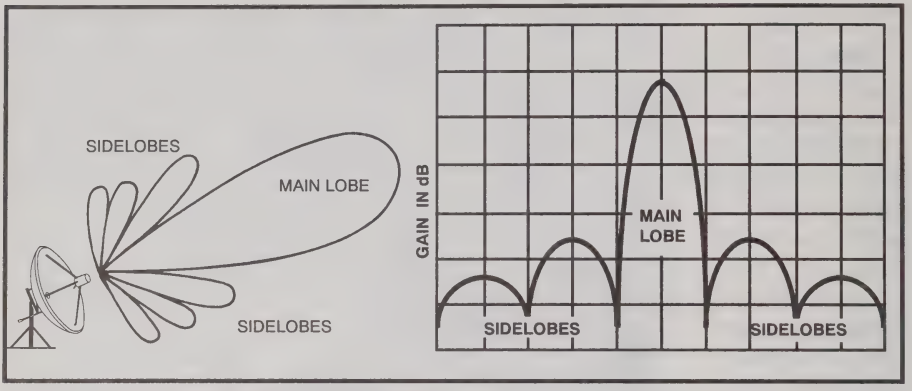


Fig.4-11. Antenna sidelobes and ideal radiation pattern.

next door will be located. Care in the design and manufacturing stages must be given to minimize the gain of the side lobes for these small antennas. When purchasing a small antenna, check the side lobe specifications to insure that the side lobe gain at 3 degrees is at least - 18 dB below that of the main antenna gain.

Mounts

The mount is often the most overlooked aspect of any parabolic antenna. The steel mount and the support bearing which holds the dish are very important since they not only carry the full weight of the dish but must also maintain a precise position once sighted onto a satellite. Changes in alignment as small as a couple of inches can make the difference between a good picture and no picture at all. One good test for any antenna's mount is to grab the rim of the dish and shake it. If the dish support has a significant amount of looseness or "slop" in it, the wind and rain will be able to shove the dish about, which will cause erratic reception at times.

Since the height in the sky and the direction of each satellite is different, any mount used must incorporate adjustments within its structure to allow the dish to be focussed on the satellite of your choice. There are three main kinds of mounts used for parabolic dish antennas: polar, az/el, and a fixed mount which receives signals from a single satellite.

Polar Mounts

Astronomers have used the polar mount for a long time because it allows their large telescopes to track stars as the earth rotates. With a polar mount, the dish antenna rotates in an arc which mimics the curvature of the Clarke Orbit. The

Fig.4-12. Polar mount with horizon to horizon motor drive. (Courtesy Hero Communications.)

Fig.4-13. Orbitron 8.5 ft. polar mount mesh antenna with linear actuator drive. (Courtesy Orbitron.)

axis of the polar mount must be installed so that it faces south (true north for stations south of the equator). Once the antenna and mount have been properly installed, the polar mount antenna can track all other satellites within view of the dish by means of a single adjustment in direction (called the azimuth). The antenna's elevation will automatically change as the dish moves east or west.

For exact tracking of the Clarke Orbit from the eastern to the western horizons, an additional adjustment called the declination must be included on the mount. The amount of declination required at any location will vary and it must be set correctly during the initial installation of the dish and mount.

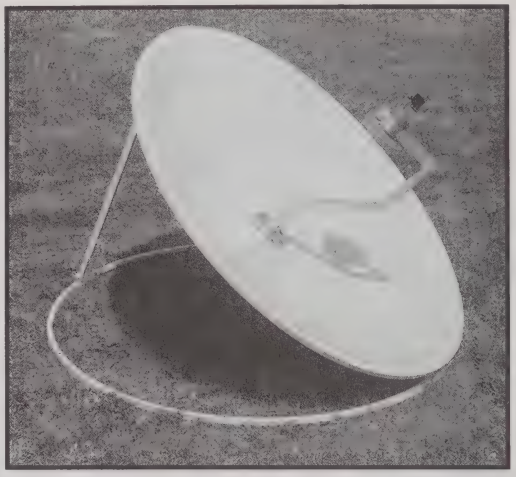


Fig.4-14. Fixed mount antennas commonly are used for the reception of a single DBS satellite. (Courtesy DH Antenna.)

El/Az Mounts

Commonly encountered in commercial rather than home satellite TV systems, the el/az mount requires the independent adjustment of both the elevation and azimuth in order to receive any particular satellite. Since it requires two adjustments in order to switch satellites, it is not easy to manually maneuver. Once you have done it a few times, it will not be a very difficult procedure. El/azmounts can also be adapted for remote control with the addition of two separate electric motors.

Fig.4-15. Flat antennas like the Japanese model shown above are being used in Japan and Europe for fixed reception of a single satellite. An embedded gridwork of tiny resonant elements receives the satellite signals and concentrate them at a common terminal point where the LNB is mounted. (Photo by Mark Long.)

Chapter 5
Feedhorns, LNBs & Polarizers

The parabolic dish is the most visible portion of any earth station's antenna system. But it is really nothing more than a reflector that concentrates the satellite signal. Once the concentrated signal has been delivered to the focal point, it must be collected and passed on to the low noise amplifier with a minimum of signal loss. This is the function of the feedhorn, which bolts directly onto the mouth of the LNB.

Feedhorns

In the early days of home satellite reception, all antennas used a rectangular feedhorn to collect the signal. Experimentation, however, showed that a circular feed was more efficient, providing up to an additional +1 dB of gain. This makes a lot of sense when you consider that most parabolic dish antennas are themselves circular.

The most common type of feedhorn manufactured today is the scalar feed, in which a series of concentric rings gathers the signal from the outer edges of the focal point and directs them into the center of the feed. Most of the signal picked up by the feedhorn is reflected by the inner 70% of dish's surface. The scalar feedhorn is designed to maximize its "view" of this area, while attenuating by 10 to 15 dB the signal contribution from the edges of the dish.

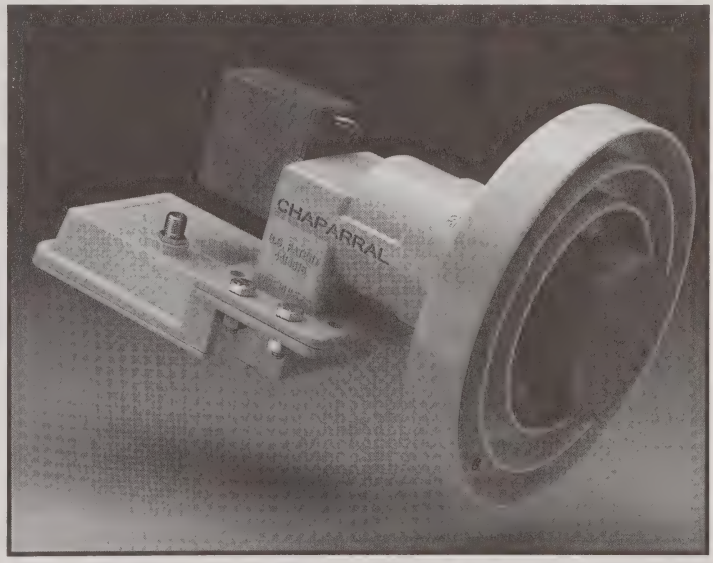


Fig.5-1. C-band feedhorn with LNB (Courtesy Chaparral Comm.)

The molecular action of the earth itself generates random noise in the 4-

GHz region many times stronger than the satellite signals reaching your location. The 10 to 15 dB of attenuation reduces the system's reception of noise generated by the portion of the Earth which lies beyond the edge of the antenna. The outer 30 percent of most dishes acts more as an Earth shield for the feedhorn than as a contributor to the overall gain of the antenna.

For optimum performance, the feed must be matched to the type of antenna that has been selected. Shallow dishes perform best with any standard feed system, while deep dishes may require a special feed or an adapter ring which lengthens the feed opening slightly. The actual length of the feed opening is directly related to the f/D ratio of the particular antenna. Feeds are available that have adjustable scalar plates which allow the unit to be manually tuned for best results.

Low Noise Block Downconverters

Once the concentrated satellite signal is funneled down inside the feedhorn, it encounters the first stage of electronic amplification: the LNB. Within the mouth of the LNB there is a short metal probe less than an inch long. This is the actual resonant antenna, which directly couples the signal to the first stage of electronic amplification.

A certain amount of noise will be generated within any electronic circuit. Any noise created by the LNB circuitry itself will be amplified and passed on to succeeding stages; for best performance, this noise must be kept to a minimum. Several years ago satellite TV systems needed much larger dishes to counteract the high noise generated in early low noise amplifiers. But with breakthroughs in gallium arsenide (GaAs) semiconductor and High Electron Mobility Transistor (HEMT) technologies, it is now possible to minimize the "noise temperature" of the LNB, and bring

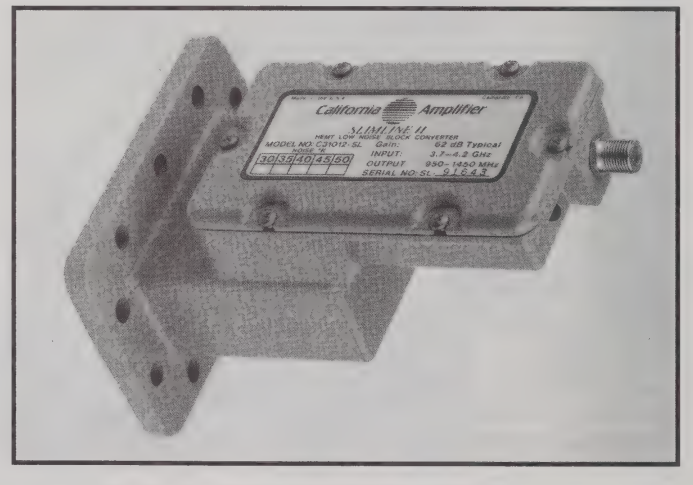


Fig. 5-2. C-band LNB (Courtesy California Amplifier.)

the cost of the product down to affordable levels as well.

The LNB noise temperature is expressed in degrees Kelvins (K). The lower the temperature, the less noise introduced into the LNB by its own circuitry. Consumer LNBs generally are in the 50 to 60 K temperature range, although other values are commonly available down to as low as 30 K.

Ku-band LNBs

Ku-band LNB noise performance is expressed as a "noise figure". This is a rating, expressed in dB, which is directly derived from the noise temperature of the amplifier. Below is a chart that shows the equivalent noise figures for most standard Ku-band LNBs.

170°	=	2.01 dB noise figure
150°	=	1.82 dB noise figure
120°	=	1.51 dB noise figure
100°	=	1.29 dB noise figure
80°	=	1.06 dB noise figure
60°	=	0.82 dB noise figure

LNB/Dish Trade-Offs

Approximately 0.6 dB of gain is added to the dish for every 20 K drop in C-band LNB noise temperature. For some installations, a 0.5 to 1 dB improvement could make the reception sparkle-free, and the installation location may not allow a larger dish antenna. Many different combinations are possible for good reception, but not all are affordable.

Another point to consider is the amount of amplification given to the received satellite signal. This is also measured in dB. Generally, consumer LNBs have 50 to 60 dB of gain, multiplying the received signal by as much as 1,000,000 times. This provides the receiver with the necessary amount of amplification for efficient operation. In most cases, the gain figure itself matters less than the LNB's noise contribution.

Vertical and Horizontal Polarization

The signals transmitted by domestic satellites such as Asiasat and Palapa are sent by an onboard dish antenna that positions the microwave energy in either a relatively vertical (straight up and down) or horizontal (lying flat) polarization. For best reception of these signals, the LNB's antenna probe must be oriented in the same plane—horizontal or vertical—as that of the desired transponder. If the orientation of the LNB's antenna probe is not

exactly matched to the satellite transponder's polarization, some of the signal will be lost. If the wrong polarization is selected for a particular transponder, you won't receive any signal at all. A slight adjustment of polarity is usually necessary when you switch from bird to bird. The amount of variance from satellite to satellite is referred to as "skew".

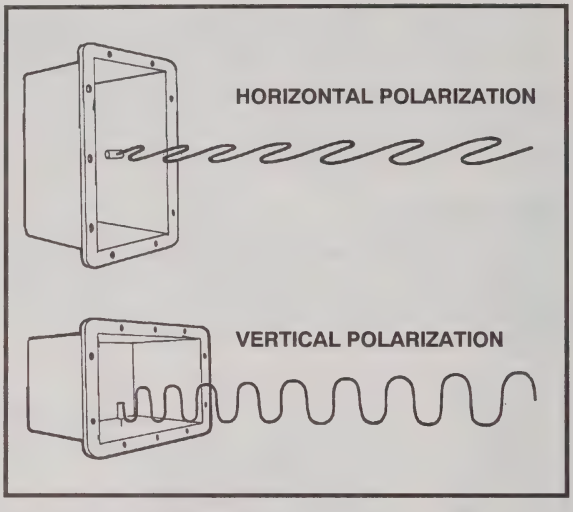


Fig.5-3.Linear Polarization.

Circular Polarization

The Japanese DBS satellites, as well as the INTELSAT and STATSIONAR satellites, use an alternate polarization format known as "circular polarization". For the best possible reception of circularly polarized satellite transmissions, you will need to use a feedhorn that has been constructed to receive these signals.

Instead of beaming the microwave energy along a "linear" plane, whether vertical or horizontal, circular polarization is transmitted in a helically rotating pattern. Although standard linear feedhorns can still pick up any circular polarized signal, half of the available signal power will be lost. There are several manufacturers that offer special feedhorns that can receive both the linear and circular polarization formats.

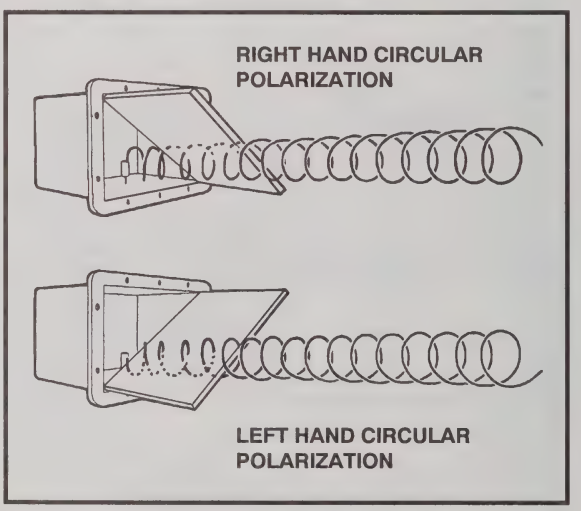


Fig.5-3.Circular Polarization.

Polarizers

Almost all commercial satellites maximize their use of the limited frequency spectrums assigned for satellite communications by overlapping the transponders, with their polarization switching from one sense of polarization to the opposite sense every other transponder. This allows twice as many channels in the same amount of space. For example, when a feedhorn has been adjusted for best reception of a horizontally polarized transponder, the overlapping vertically polarized transponders cannot be seen. If the feedhorn inadvertently is set somewhere between vertical and horizontal polarization, it is possible to see more than one transponder at the same time, an unsatisfying viewing experience at best.

In order to select the correct polarization, most feedhorns incorporate a small probe that is rotated until best reception is obtained. The probe is rotated by means of a small servomotor which is powered by either the indoor receiver or antenna positioner. By sensing the strength of the incoming signal, some receivers can select the correct polarization automatically. Many microprocessor-based receivers and IRDs can be programmed to recall the correct polarization format for each individual satellite stored in their memory.

A few manufacturers have figured out a way to eliminate all mechanical parts by electronically polarizing the LNB, instantaneously and silently. Rather than adjusting a servo-driven probe, these circuits electronically alter the polarization of the incoming microwave signal. This does introduce a small amount of signal loss, typically 0.1 to 0.2 dB, which for most applications is negligible. Electronic polarization provides instantaneous polarization adjustment with no moving parts that can give you maintenance problems in the future.

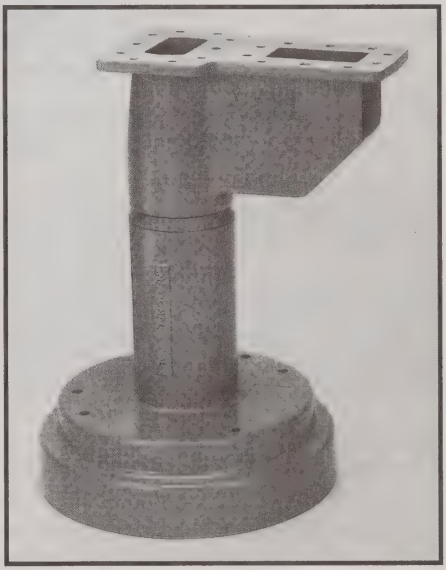


Fig.5-5. A dual polarization, circular/linear, C-band feed. (Courtesy National ADL.)

Dual Feeds

There are special feeds available which can be used to mount two C- or Ku- band LNBs at the focal point of the dish for simultaneous recep-

tion of both senses of polarization. These special "dual feeds" are used by multiple receiver systems so that each receiver in the system can independently select transponders of either polarization from a given satellite.

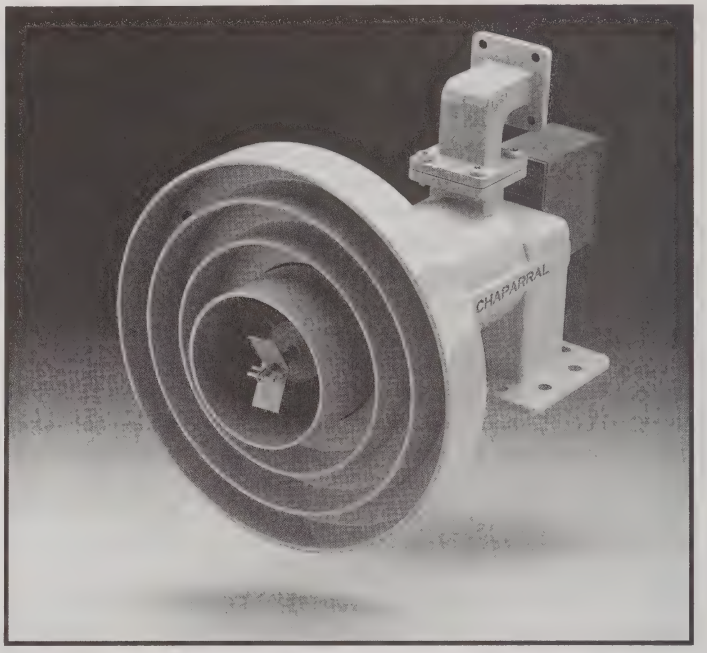


Fig.5-6. Dual-band feedhorn. (Courtesy Chaparral Communications.)

Hybrid Feeds

Dual-band "hybrid" feeds place both the C- and Ku-band feed openings directly at the focal point of the antenna to provide the best overall reception from the maximum number of satellite TV channels. Although the placement of both the C- and Ku-band feed openings at such close proximity to each other results in a slight amount of signal loss at C-band, this loss will only affect the reception of the weaker C-band satellite channels. Hard-core videophiles can compensate for the nominal loss at C-band by switching to a lower noise temperature C-band LNB.

Owners of commercial and multiple receiver home systems who wish to receive both C- and Ku-band transponders may purchase dual C-band, single Ku-band feeds or dual C-band, dual Ku-band feeds.

Chapter 6
Satellite TV Receivers

Satellite TV receivers and integrated receiver/descramblers (IRDs) come with a wide range of features and options. You may be quite satisfied with a basic "no frills" receiver that provides a good picture into your home. After all, it doesn't matter whether you are driving a Honda or a Ferrari, you can still get around. On the other hand, the more expensive units generally add features that improve performance or provide increased versatility. When choosing from the variety of equipment in the marketplace, it is a good idea to review all of your options before you purchase, so you know the receiver which you select is the right one for you.

The Basic Considerations

When you go to purchase your system the salesperson should ask you a few questions about what features you would like. This will help to narrow down the available field of options and help determine the correct package for you. The price will vary a great deal between the low and high end systems. Knowing as much as possible about receivers and the available options will help you to be a smart consumer. Here are some of the typical questions which you may be asked:

Will the satellite receiver be connected to more than one TV in the home? If so, a UHF remote control is a handy option that will allow you to control the main satellite receiver from other rooms in the home.

Will you want one person be able to watch a satellite channel in the living room while another member of the family watches a different satellite channel in another room? In this instance, two receivers will be required.

Do you want to watch scrambled channels on both receivers? You will need a descrambler for each receiver in order to do so.

Do you want to receive stereo audio from the non-scrambled channels? While the vast majority of the scrambled channels provide digital stereo, many of the non-scrambled channels as well as a host of auxiliary audio services (radio stations and specialty services) also are available in stereo, provided that your receiver has the appropriate stereo options.

Will you want to watch Ku-band as well as C-band satellite TV programming or be able to easily upgrade from a single to a dual band system at some

point in the future? Make sure your dish and receiver are dual-band compatible.

We will explore the basic operational functions of satellite receivers and examine most of the available optional features in this chapter, starting out by describing integrated receivers.

Integrated Receivers

The first so-called "integrated" receivers were introduced in the United States back in 1984 when satellite manufacturers began to combine the satellite TV system's receiver, stereo processor, polarizer, and antenna positioner in one streamlined unit. These systems were the first step toward simple, automatic selection and tuning of satellite TV channels.

Today's integrated satellite receivers have evolved into full-blown computers. With special software programs built in, they function as the master control for the entire satellite TV system. Some integrated receivers carry so much memory that they are comparable to desktop personal computer systems. The receiver's wireless remote control has become a kind of keyboard and the TV set serves as a computer screen for displaying a variety of personal-computer-style menus that give the operator total control. The trend is toward flashy, highly-graphic video systems that can do it all.

Suprisingly, the very complexity of these computer-driven receivers makes them easier to use than ever before. They are pre-programmed at the factory to keep track of all the settings necessary for receiving your favorite satellite TV channels. All you have to do is select your favorite satellite TV channel from a menu displayed on the TV screen and the system does the rest. You don't even need to know which satellite is carrying the channel. Moreover, you can rely on the computer's electronic brain to remember and execute all the little adjustments required for perfect reception.

In their quest for simplicity of operation, however, manufacturers of integrated receivers have not forsaken technically-minded dish owners who enjoy having access to a plethora of electronic goodies. If you don't care to keep it simple, there are enough high-tech menus and advanced function commands to keep even the most avid "techie" happy.

Remote Controls and On-screen Graphics

Most receivers are provided with remote controls. While some receivers still have front panel controls and an LED readout of the satellite name and channel number, most units now provide remote controls that can command the receiver to perform all available functions; in this case few or no control buttons will be found on the front panel of the receiver itself. Pushing

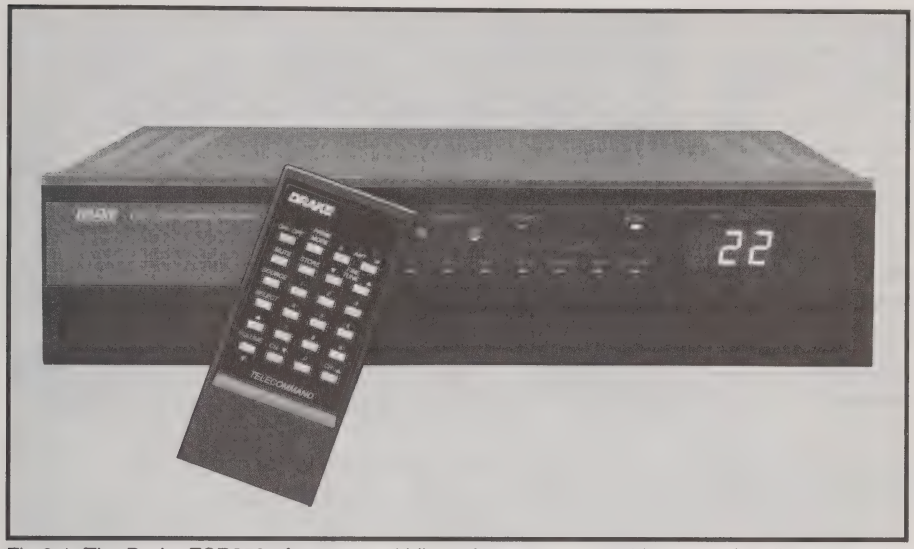


Fig.6-1. The Drake ESR250e features multi-lingual, on-screen graphic menus for all programming functions, a built-in four-event VCR timer, and full stereo compatibility with all of the STAR TV program services carried by Asiasat. (Courtesy R. L. Drake Company.)

various buttons on the remote control will bring up on-screen (on the screen of your TV) menus which provide you with a selection of possible choices.

In addition to guiding you through the installation instructions, most satellite receivers also use on-screen graphics to display relevant information on the working status of your system. Whenever you change channels, for example, the name of the satellite and the channel number will appear momentarily on the TV screen. On-screen graphics is a convenient feature to have when viewing satellite programming from a location where you can't see the readout provided on the front panel display of the receiver. The on-screen graphics and remote control work together to provide you with total hands-free operation of your satellite TV system.

Remote controls come in two varieties: infra-red and UHF. The infra-red remote controls transmit an invisible light beam back to the receiver, which has a sensing window on the front control panel. Infra-red remotes, however, are limited to line of sight operations.

UHF remotes use a radio frequency to send the control signals back to an antenna mounted onto the receiver. Since UHF remotes use a radio signal instead of a light beam, the transmissions aren't limited to line of sight of the receiver. The combination of a UHF control and on-screen graphics allows for

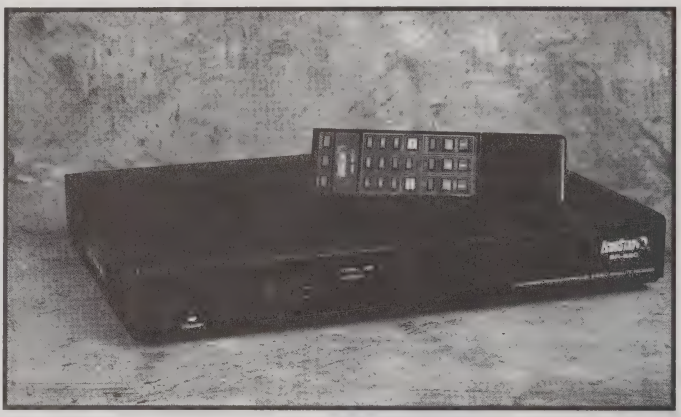


Fig.6-2. The Echostar SR-520 features pre-programmed Asiasat, Palapa, Aussat, INTELSAT, and Chinasat services, Asiasat stereo audio tuning, favorite video and audio channels, and an infra-red remote control. Also available: descrambler hook-ups and C/Ku-band compatibility. Courtesy Echosphere International (Asia).

convenient operation of the receiver from different rooms in the house.

If there are two satellite receivers in the home, UHF cannot be used to control both units, because the remote control for one receiver would interfere with the other. Some receivers provide for both infra-red and UHF remote control operation. Infra-red is used in the room where the main receiver is located while UHF is used from all other rooms.

Remote Functions

Hand held remote controls can range from the very simple to the very sophisticated. Most satellite receiver remotes allow you access to a wide variety of functions and special features. Since there can be many different ways of accomplishing the same task—and some receivers will offer more features than others—the remote controls for different brands and models of receivers will be designed slightly differently. Here is a list of common remote functions:

Channel Up/Down. Designated keys on the remote will select which of the available transponders you want to see. Individual channels can be accessed either by directly entering their number on the remote's alpha numeric keypad or pushing the channel up/down button.

Antenna Positioning. Designated keys on the remote are used to access the receiver's programmed entries for the positions of the available satellites. In most cases, the receiver can be commanded to move to a new satellite by entering a two digit alpha numeric code (such as A1 or P2 for Asiasat 1 and Palapa B2P) for the desired satellite. Additional keys are used to fine tune reception by moving the dish slightly to the east or west.

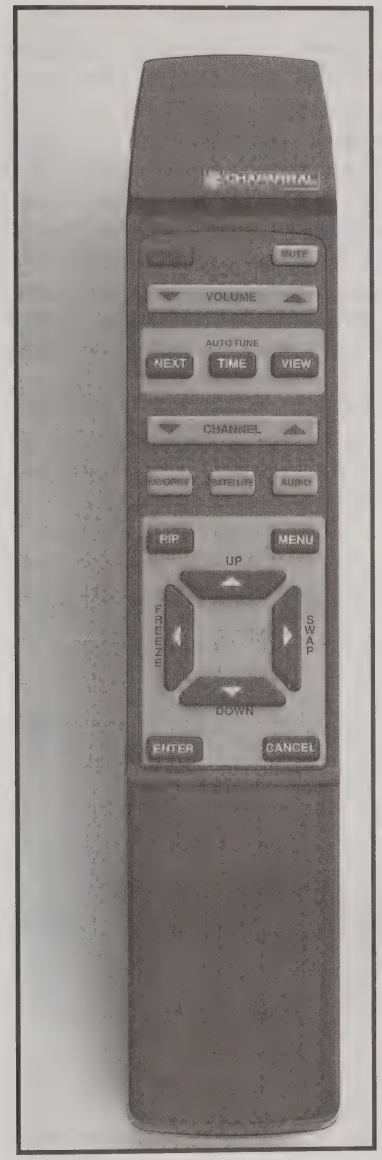


Fig.6-3. Remote control. (Courtesy Chaparral Communications.)

Volume Up/Down. You can push the volume up/down button on the remote to control the audio level. Many remotes also come with a "mute" button that can be used to zap commercials and other annoying audio phenomena.

Menus

The remotes for those receivers which offer on-screen graphics have a keystroke command that provides the viewer with access to a series of computer-style menus. Categories of menus include: installation set-up, satellite, channel, favorite channel, and audio tuning. Each menu contains a list of several related functions. The following functions commonly are included under one or more of the receiver's menus:

Satellite Format. Most receivers have been designed to effectively process both C- and Ku-band signals. The receiver, for example, can automatically choose a 24-channel format whenever a C-band satellite has been selected or a 32 channel frequency scheme whenever a corresponding Ku-band satellite has been selected. Moreover, the satellite format menu can be used to adjust and store in receiver memory the location, polarization, and skew settings for each individual satellite.

Channel Format. Some receivers and IRDs come from the factory with the channel format settings for the available satellites already programmed into memory. Satellite services, however, often move from channel to channel—or even satellite to satellite. What's more, new satellite services are being launched all the time. It therefore is important that dish owners have a way to change the various settings that are stored in the

receiver at the factory.

The operator can custom program the receiver on a channel-by-channel basis to select special video and audio frequencies, enable or disable the descrambler module or engage video and audio band pass filters.

Favorite Video and Audio Channels. Some receivers also have the ability to retain up to 100 favorite stereo or monaural audio services as well as 100 favorite video services in memory. A directory of favorite video and audio services can be displayed at any time on the screen. Each favorite service is assigned a unique code which can be keyed via the remote control. By punching in the number for your favorite service of the moment, the dish will automatically careen toward the satellite which carries the service and the receiver will automatically select the correct channel frequency and audio subcarrier parameters.

Audio Format. Every unscrambled TV transponder carries the audio portion of the program on a subcarrier which is offset from the frequency of the main video carrier. Additional subcarriers on any transponder can also carry broadcast radio, news, or other "auxiliary services".

Fig.6-4. The Star Track 150 features fully synthesized, drift-free tuning of all video and audio frequencies, an infra-red remote control, 72 programmable favorite video channels, Panda I stereo compatibility, and parental lockout. (Courtesy TEE-COMM.)

The audio menu is selected when tuning in to the desired subcarrier on any satellite TV channel. The main monaural subcarrier frequencies commonly used by the Asiasat and Palapa satellites are 6.2, 6.3, 6.48, 6.6, and 6.8 MHz. Auxiliary services may be found anywhere between 5.0 and 8.2 MHz.

Asiasat's STAR TV services also broadcast their programs in stereo using the Panda Sound System. The receiver that you select must be fully compatible with the Panda system in order for you to enjoy STAR TV broadcasts in stereo. Moreover, for full stereo sound to be produced by your receiver, the Panda I stereo mode and correct stereo subcarrier pairs—5.58/5.76 MHz (Northern Beam) or 6.30/6.48 MHz (Southern Beam)—must be selected and programmed into memory for each available STAR TV service. Some receivers may have had the stereo audio settings for existing services programmed into memory at the factory.

Most stereo receivers also provide for the selection of a wide or narrow audio filter. While the monaural audio for any satellite TV channel is always carried in the wide audio format, stereo TV broadcasts and auxiliary subcarrier services may be carried in a narrow audio format. The reception of these narrowband audio services will be enhanced by engaging the narrowband audio filter. Most receivers can store the narrowband setting in memory on a channel-by-channel basis.

Optional Features

In addition to the standard features described above, many receivers come with a dazzling array of "bells and whistles"—exotic features that can enhance the performance of your satellite TV system. The following are some of the more commonly encountered optional features.

Auto Install. The installer merely has to find the first two satellites and the receiver will automatically locate the remaining satellites and program their locations into memory.

Auto Peak. After each satellite has been located, the receiver automatically selects the correct polarization format, skew setting, and video center frequency for every channel. The operator also can select auto peak at any time to readjust the antenna, polarization, skew, and channel settings for maximum performance.

Unfortunately, the auto peak feature is not perfect. When using auto peak, observe the reading of your receiver's *signal strength meter* to insure that maximum system performance has been obtained. This meter either will be found on the receiver's front panel or as part of the on-screen graphics menu. You can always use the receiver's manual controls to touch up any adjustments made after initiating an auto peak if necessary.

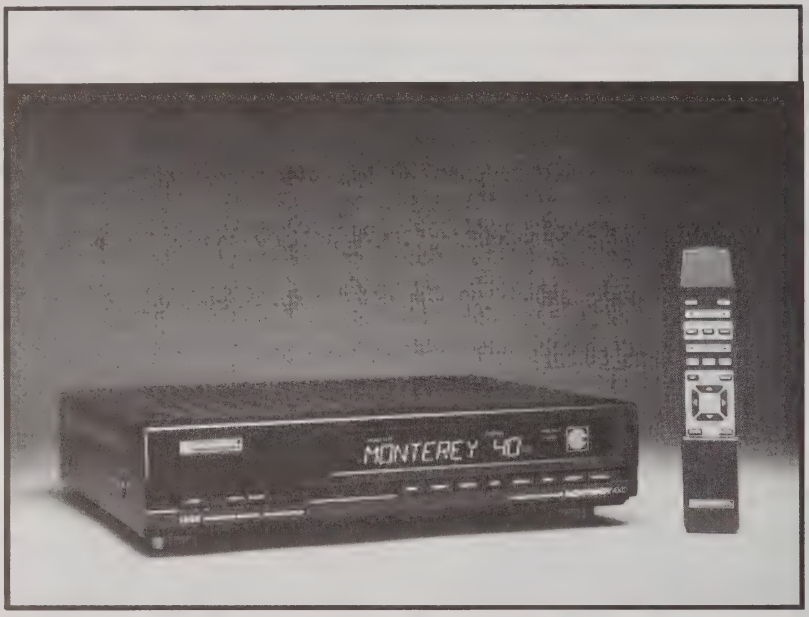


Fig.6-5. Monterey 40. (Courtesy Chaparral Communications.)

Chaparral Monterey 40 International Satellite Receiver

Standard Features: Full-color on-screen graphic menus, infra-red remote control, Wegener Panda 1 audio, and dynamic noise reduction. A front panel liquid crystal display (LCD) shows the names of channels being viewed in a large backlit window. The LCD readout also displays the status of other receiver operations.

Special Features: A built-in four-way video/audio switcher that provides access to three additional video sources—such as a VCR, a laser disc player, or your home's local TV antenna—and their accompanying stereo audio signals. A four-stage selectable bandwidth filter allows you to obtain maximum system performance when viewing different satellite systems. An AutoTune feature that automatically adjusts the feedhorn's polarization and the antenna's alignment for maximum signal performance.

Also Available: Name and store up to 100 favorite video or audio channels for instant access anytime. A programmable video recording timer turns on the system, moves the dish to the correct satellite, and selects the right channel for the program to be recorded—even when you are not at home. Restrict access to designated channels through the assignment of your own "secret" password.

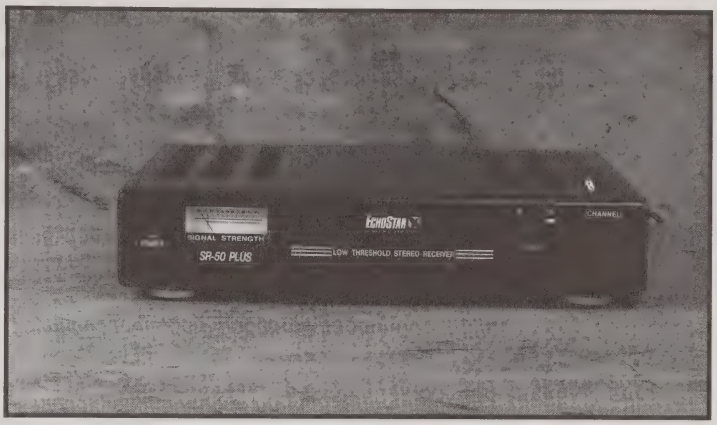
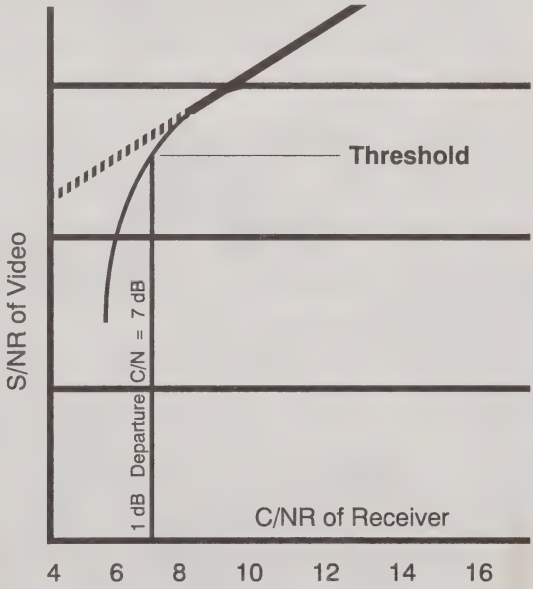


Fig.6-6. Echostar SR-50 Plus Satellite TV Receiver (Courtesy Echosphere International.)

T.I. Filters. Many receivers also come with built-in filters which can be used to eliminate interference generated by terrestrial microwave links which share frequencies with the C-band satellites. These switchable terrestrial interference (TI) filters can be engaged manually by the operator whenever needed. Filter settings also can be stored in memory on a satellite-by-satellite and channel-by-channel basis.

Threshold Extension or Video Noise Reduction Filters. These filters can be used to improve receiver performance when viewing some of the weaker satellite TV channels. Threshold extension filters also can enhance the quality of reception from certain Ku-band satellite TV services that are transmitted within a much narrower

Fig.6-7. Threshold is the point where the relationship between the signal to noise ratio (S/NR) of the video and the carrier to noise ratio (C/NR) of the incoming satellite signal is no longer linear.



frequency bandwidth (24 versus 36 MHz) than their C-band counterparts.

Receiver manufacturers try to maximize the incoming signal strength while keeping both external and internal noise to a minimum. This relationship is expressed as the Carrier to Noise Ratio (C/NR).

Every receiver has a threshold point (expressed in dBs C/NR). When the C/NR falls below this point, the video rapidly becomes noisy. Once the C/NR is a dB or more above threshold, impulse noise or "sparklies" disappear. The lower the receiver's threshold rating, the better. It is usually 7 to 8 dB C/NR.

Threshold Extension and Video Noise Reduction filters lower the receiver's C/NR through the use of specially shaped bandpass filters and other processing circuitry. Lowering the receiver's C/NR threshold has the same effect as if you used a lower noise temperature LNB or bought a larger antenna.

VCR Timer/Automatic Video Taping. Like VCRs, some receivers now come with circuitry that will permit the taping of multiple events over a period of two or more weeks. VCR-compatible receivers have their own internal "real time" clocks. The operator merely selects the satellite, channel, "on" time and "off" time for several events and the receiver's microprocessor will automatically move the dish, select the channel, and forward the video and audio signals on to your VCR for recording. However, you still must remember to pre-program your VCR to record the selected programs as they occur.

The VCR timer feature also can be used to fully automate your dish so that young children can view their favorite programs on schedule without needing adult assistance. By using the receiver's VCR timer circuitry, the entire satellite system may be completely programmed by the user at the beginning of each week to automatically adjust the system to specified channels at the designated times. When this occurs, all the kids will have to do is sit back and enjoy.

Before purchasing a satellite receiver, make sure that its taping capabilities match your specific needs. A satellite receiver, for example, may feature several levels of programmability. When placed in the "one-time" program mode, the receiver can be programmed to tape five individual events that occur at any time; when in the "weekly program" mode, each stored event will occur on time every seven days until deleted; and the "daily program" mode permits up to five events to be taped every day until deleted. Full memory protection is provided so that momentary power outages will not preempt the program which you have entered into the receiver's microprocessor.

Parental Lockout. You can program certain satellite TV channels so that

they only can be accessed by keying in a special secret code. This feature can be used to prevent children from gaining access to services which you do not want them to watch.

Panda Sound System. To enjoy STAR TV's high quality stereo transmissions of program audio, make sure that you purchase a satellite receiver that is Wegener Panda 1 compatible.

Dolby Surround Sound. This is an audio enhancement that gives spatial depth to the audio broadcasts of major sports events and movies. The surround sound audio processor decodes the special surround sound signals and sends them to the home entertainment system's front and rear pair of stereo speakers.

PCM Audio. The receiver must feature Pulse Code Modulation (PCM) audio tuning if you are to enjoy the digital audio transmissions transmitted by the TV services on the Japanese BS-3A and BS-3B DBS satellites.

Receiver Specifications

For those consumers not familiar with electronics, the technical specifications advertised within the sales literature can be baffling. Here is a list of some of the common satellite receiver specs and what you should look for when selecting equipment.

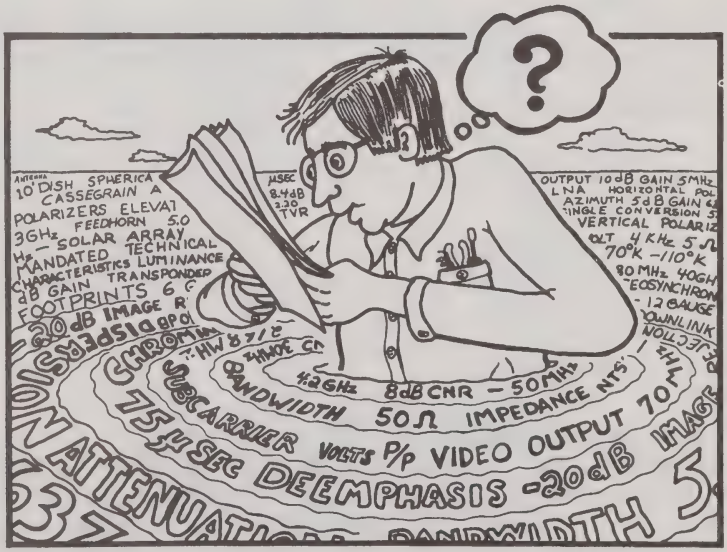


Fig.6-8. Lost in a sea of mindless technical babble.

TYPICAL SATELLITE RECEIVER SPECIFICATIONS

RF	
Input Frequency:	950 to 1450 MHz
Input Impedance:	75 ohms
2nd IF:	70 MHz
IF Bandwidth:	27 MHz
Threshold:	Less than 7 dB C/NR
VIDEO PERFORMANCE	
Standard:	NTSC, and PAL-B/G, switchable [NTSC—Japan, South Korea & the Philippines] [PAL—Asia, Australia, Burma, & New Zealand] [SECAM—Russia & Mongolia]
No. of Channels:	24 at C band; up to 32 at Ku band
Output Impedance:	75 ohms
Output Level:	1 volt peak to peak
AUDIO PERFORMANCE	
Audio IF Bandwidth:	280/150 kHz selectable
Subcarrier Frequency:	5.0 to 8.5 MHz
Audio Modes:	Mono & Panda 1 Stereo PCM (BS-3A and BS-3B)
Preemphasis:	75 μs
Peak to peak deviation:	100 kHz
Frequency Response:	+0/-3 dB 50 Hertz to 15 kHz
RF MODULATOR	
Output Frequency:	VHF (Ch. 3/4) or UHF (Ch. 32~40)
Video Standard:	PAL-B/G or -I switchable; or NTSC-M depending on intended country of use
POWER REQUIREMENTS	
Primary power:	120 or 240 volts a.c., switchable
Power to LNB:	18 Volts d.c. Nominal @ 300 mA maximum
Polarizer Output:	5 Volts d.c. Nominal @ 500 mA maximum
ACTUATOR INTERFACE	
Motor Power:	36 Volts d.c. nominal, 3 A maximum
Sensor Type:	Pulse, compatible with reed, relay, optical disk or hall-effect switch; 5 Volts d.c.

Chapter 7
The Big Dummy's Guide To Satellite Installations

Although the vast majority of satellite TV purchasers leave the installation of their home satellite TV systems to experienced technicians, an increasing number of individuals are electing to install their own systems. A third popular option is to undertake the bulk of the installation yourself, including mechanical parts such as assembling the dish and running the cables, and then have a technician tackle the more complicated installation steps, such as adjusting the dish so that it will properly track the satellite arc or programming the satellite receiver. The satellite technican can complete both of these steps quickly and easily once the equipment is in place. If you have not previously operated a satellite TV system and aren't sure what to expect, the technician also can walk you through the basic operating procedures, explain all receiver functions, and give you confidence that you will be getting the most you can out of your new system.

*Fig.7-1. During the 1970s, **The Big Dummy's Guide to CB Radio** introduced millions of people around the world to all the technical ins and outs of a highly-popular, consumer-oriented communications medium. Well, hold on to your hats, because here we go again!*

Your satellite retailer should have a technician available or be able to recommend one to you. He also should supply you with the information that you will need in order to track the satellites that are available from your location: azimuth, elevation, and declination angles. If not, you can derive this information from the charts provided within this chapter or obtain the data by taking readings off another working antenna in your area.

Your antenna and electronic components will come with assembly and operating instructions. The following step by step guide will walk you through the installation and explain the various procedures that you will perform along the way. Whether you decide to tackle the installation on your own or to hire a technician, an understanding of site selection criteria, cable connections between components, and dish aiming techniques will improve your operating skills and increase your enjoyment of the system.

Site Surveys

Satellite signals are microwaves that travel in a straight path along the line of sight. Since all geostationary satellites are positioned over the Earth's equator, if you want to receive them from the northern hemisphere, your antenna must have an unobstructed view of the southern (or northern for sites located below the equator) sky. So, before you go running out and spending hundreds or even thousands of dollars for an earth station, you should be sure there are no tall buildings, trees, power poles, or other substantial obstacles to prevent the signals from reaching your dish.

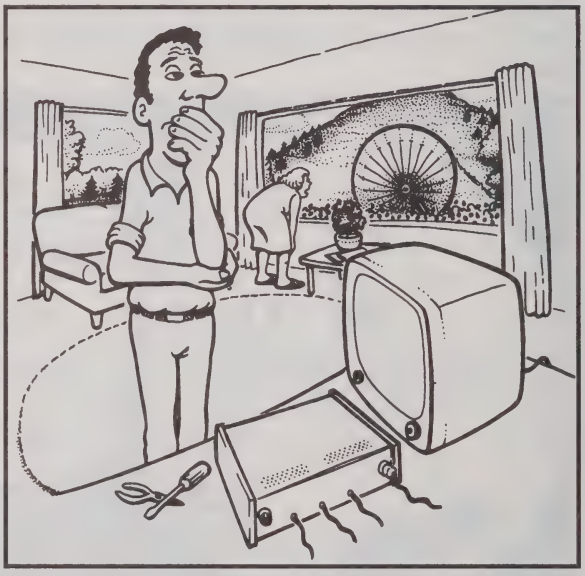


Fig.7-2. "Dear, I may have found the reason you can't pick up anything with the dish."

Your local satellite retailer usually can conduct a site survey at your location; often the fee for his service is deducted from the eventual purchase price of a system. If the site survey takes place in the late Fall or Winter,

you may need to take into account the foliage of nearby trees and bushes that will be in place during the Spring and Summer months. Future construction plans of neighbors or nearby businesses also must be considered; any new buildings could be in a position to affect your reception.

You can conduct your own preliminary survey by standing in your backyard and looking toward the south (or north for sites located below the equator). If you have a clear and unobstructed view of the sky from the southeast to the southwest (or northeast to northwest) then you are in luck. However, the view from many installations—especially those in urban or suburban areas—will be blocked in some direction. At these restricted sites, some satellites may not be in view. To determine which satellites will be visible from your earth station, you will need to learn some basic techniques for locating the birds.

Azimuth and Elevation

Azimuth and elevation are the two basic coordinates used to determine each satellite's position in the sky. The azimuth coordinate represents the bearing of the satellite from your location, while the elevation is the angle at which the dish looks up at the bird. Every satellite within view of a specific installation has its own unique pair of azimuth and elevation coordinates. Given the site's latitude and longitude, the az/el coordinates for any satellite are fairly simple to calculate. The charts which appears on the following pages provides the exact azimuth and elevation coordinates for Asiasat and Aussat.

Once you know the azimuth coordinates for a specific satellite, you can use a compass to point the antenna in the right direction. To achieve the required accuracy, you must correct the compass readings for true north (or true south for locations below the equator); you can

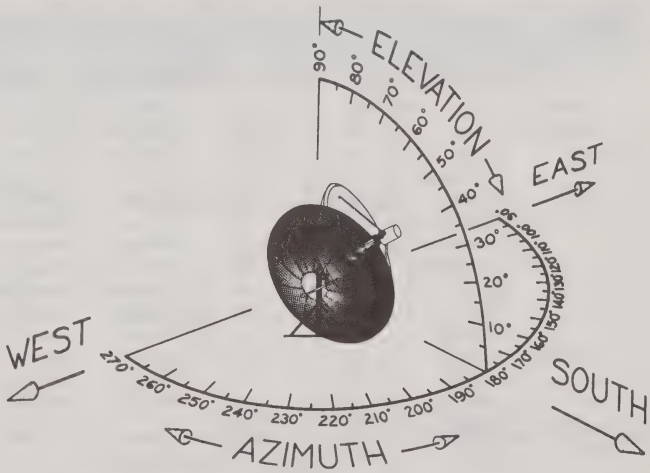
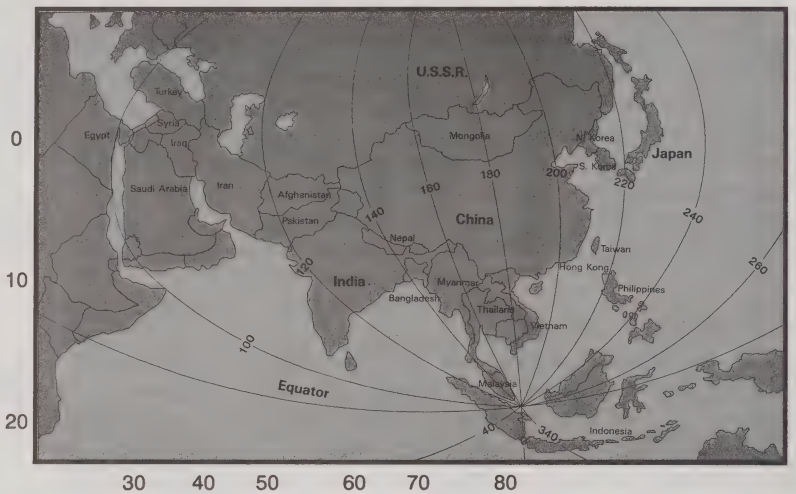


Fig.7-3. Azimuth and elevation coordinates for site locations which are north of the Earth's equator.

Asiasat 1 at 105.5 ° East

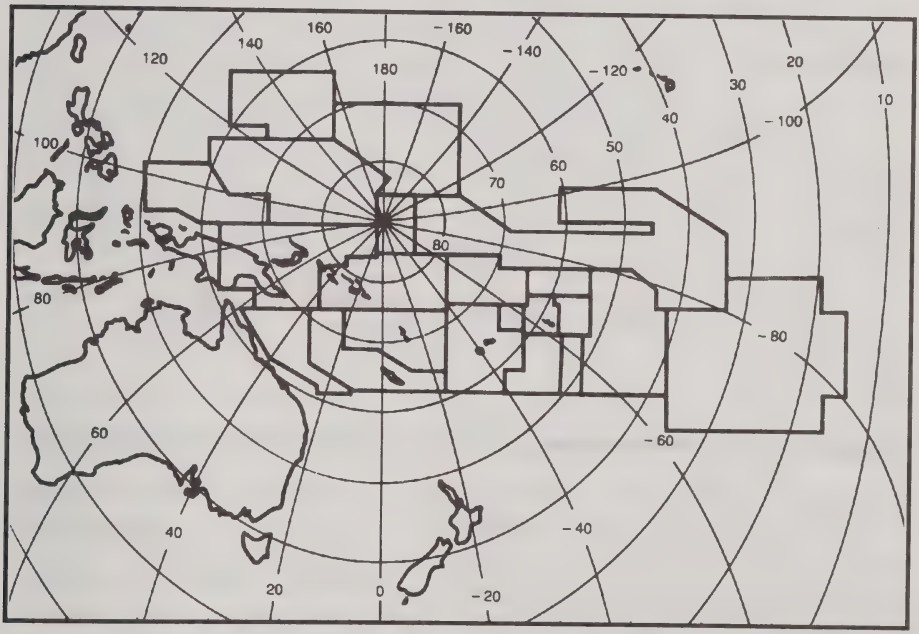


Territory	Cities	Elevation Degrees	Azimuth	Territory	Cities	Elevation Degrees	Azimuth
Afghanistan	Kabul	34	128	Malaysia	Kuala Lumpur	84	127
Bangladesh	Dhaka	58	146	Mongolia	Ulananbaatar	35	182
Brunei	Bandar Seri Begawan	78	244	Myanmar	Yangon	68	150
				Nepal	Kathmandu	52	146
China	Beijing	43	196	Pakistan	Karachi	40	119
	Guangzhou	62	199		Islamabad	39	130
	Chengdu	56	177	Philippines	Manila	65	227
Hong Kong	Hong Kong	62	202	Saudi Arabia	Riyadh	20	104
India	Delhi	45	132	Singapore	Singapore	88	130
	Bombay	51	121	Sri Lanka	Colombo	59	102
	Madras	57	116	Taiwan	Taipei	55	215
Indonesia	Jakarta	83	349	Thailand	Bangkok	73	160
Iran	Tehran	21	113	Turkey	Ankara	05	101
Iraq	Baghdad	16	107	Viet Nam	Hanoi	65	180
Japan	Tokyo	35	229		HCM City	78	185
Korea	Seoul	42	213				

Fig.7-4. Asiasat Azimuth/Elevation Coordinates (in degrees).

156 degrees east longitude

160 degrees east longitude



164 degrees east longitude

Fig. 7-5. Aussat azimuth/elevation coordinates for satellites at 156, 160, & 164 degrees east longitude.

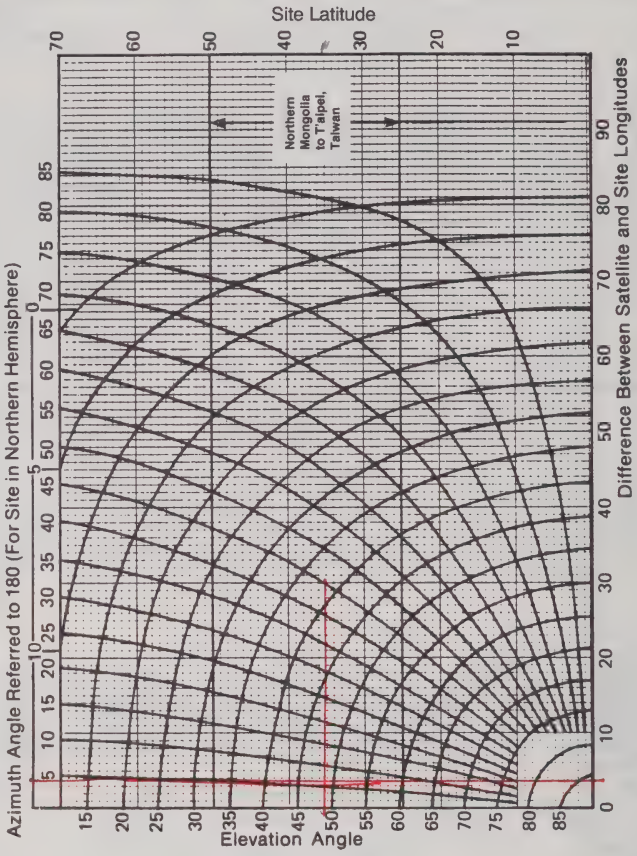
Fig.7-6. Scientific Atlanta's Universal Azimuth - Elevation Look Angle Chart.

1. Subtract site longitude from desired satellite longitude and plot this value on the bottom scale of the chart.

2. Plot the site latitude using the scale on the right side of the chart.

3. At the point where A and B intersect, determine the elevation angle and difference in azimuth using their respective graphs.

4. If the value obtained in step 1 is a positive number, add the difference in azimuth from step 3 to 180 to obtain the azimuth heading from true north. If the value is a negative number, subtract the difference in step 3 from 180.



call up the control tower at the nearest airport to find out the correction factor for your location. If true north is east of magnetic north, the correction factor must be subtracted from the compass readings; when true north is west of magnetic north, the correction factor is added. All compass readings should be taken out in the open, well away from large metal objects or overhead a.c. power lines and transformers.

From any location, the satellite nearest to true south (true north for stations in the southern hemisphere) will be at the highest point of elevation

of all the birds. The further away the satellite's bearing is from due south (or due north), the lower its elevation will be. At some point, the elevation of satellites to the extreme west or east of your location will fall below the horizon, preventing reception. That is why satellite TV stations in Asia cannot view North American domestic satellites, and vice versa.

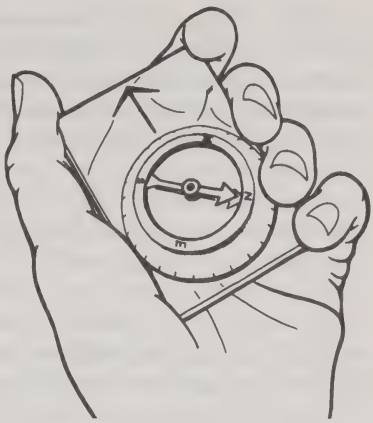


Fig.7-7. An inexpensive compass.

An inclinometer is used to measure the degrees of elevation, or "tilt", of the dish. Inclinometers, which sometimes are referred to as "angle finders", are readily available from sources within the satellite TV industry. Hardware shops and department stores may also sell inclinometers to carpenters who use them to measure roof pitch angles.

An inclinometer also can be used during the site survey to determine whether obstructions would block out any of the available satellites. Position the inclinometer on a level surface at the center of the site, and line it up with the bearing, or "azimuth", of the satellite under consideration. Then you can tilt the inclinometer back until it indicates the desired satellite's elevation. By sighting along the edge of the inclinometer, you should be able to tell if any obstacles would be between the site and the satellite.

If you determine that there will be obstructions that will interfere with your reception of a single satellite or even several satellites, then you may elect to remove these obstacles. In some cases the elimination of a troublesome tree branch may suffice. Where the obstruction is part of a nearby building or hill, the proposed dish site sometimes may be moved from

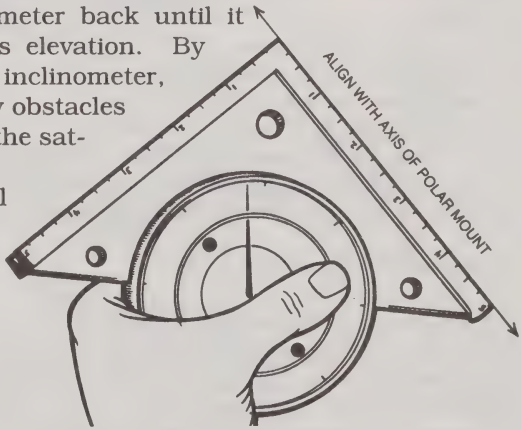


Fig.7-8. Do not be confused by two-edged inclinometers. You will get one reading when you hold it against one edge, and another reading when held against the other edge. Use the edge underneath the "0" degree mark on the inclinometer's scale.

ground level to a more advantageous rooftop location. A tall pole extending from the ground up the side, and anchored to, the house may allow the antenna to peer over the roof and receive a clear view of the satellites while not actually being anchored to the rooftop. For extreme cases of obstruction, however, the avid video enthusiast may have to consult a real estate broker.

Microwave interference from land-based telephone transmitting stations also can restrict or even preclude satellite reception. If your home is between two of these microwave links, your reception may be affected. In some areas, especially around airports, shipyards, or military installations, there are other microwave services which can affect your reception.

The best way to check for microwave interference is to have your local satellite TV retailer perform an on-site demonstration with a portable dish. To detect all potential interference, the test should be performed right at the spot where the proposed dish will stand. A difference of only a few feet can be critical.

The ESSENTIAL SATELLITE INSTALLATION KIT
(What You'll Need Before You Start)

Tools

Compass & inclinometer
Post hole digger & pointed shovel
Screwdriver, tape measure, crimp tool
Wire strippers, wire cutters, razor knife
Electrical power cord with multiple a.c. outlet
Large and small adjustable wrenches and at least one 7/8 inch wrench
Drill with large bit (masonry for concrete block or wood bit for frame homes)

Supplies

Plastic wire ties
Voltage surge protector
Quick setting concrete mix
Connector sealer (Coax-seal, etc)
Current Satellite TV Program Guide
Ground rod, clamp, and copper ground wire
"F" connectors (RG-56 type for direct burial cable)
Direct burial cable with two coaxial cables, one servo, and one actuator motor cable
Steel pole of the correct length and outside diameter for your dish's mount
Plastic plate to cover the hole in the wall where the cable enters the house.

Any on-site demonstration should be made on a weekday, when telephone and other microwave traffic is at its peak. If you are in a business area, test during business hours; in a residential area, check it later in the day. In the event that some interference is present at your location, there are filters available that can often eliminate it. Information is provided on microwave filters in the chapter on troubleshooting.

In some communities, there may be zoning or town planning ordinances that limit satellite TV installations. Make sure that your system will comply with them.

Pouring the Pad

If you elect to proceed with the installation yourself, you will need to construct a foundation for the mount. In the case of a pole-mount antenna, a steel pipe is placed in a hole in the ground and embedded in concrete. Because it will take a few hours for the concrete to harden, it is a good idea to set the pole the day before you construct the antenna. You also can buy quick drying concrete products which will set up in less than an hour. Be sure to use a level to ensure that the pipe is "plumb" before the concrete sets.

Other types of dish mounts will require a concrete pad for the foundation. Concrete piers extending well below the frost line should be incorporated into the pad design. Certain types of antenna mounts merely need a level surface. Detailed instructions are supplied by the dish manufacturer.

For rooftop installations, the roof structure must be able to support the weight of the dish, as well as withstand the uplift forces of several thousand pounds resulting from moderate and high-speed winds. After all, nobody wants the roof torn off and the dish flung through the sky.

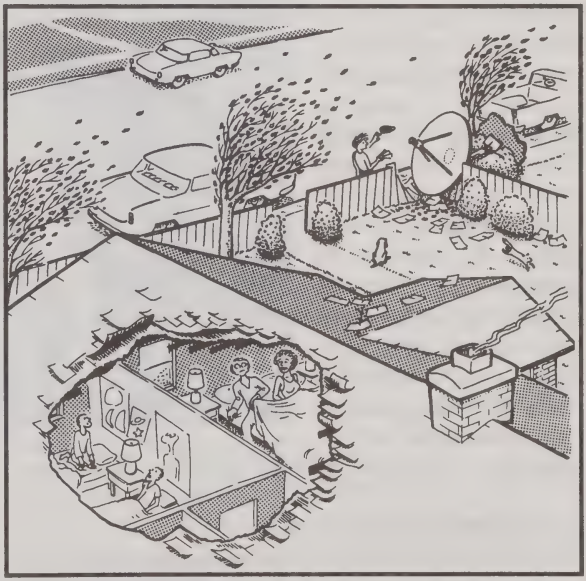


Fig.7-9. Roof mounts must withstand high wind loads.

Because roof top installations are more susceptible to microwave interference than those on the ground, a site survey with a spectrum analyzer or an on-site rooftop demonstration with a small portable dish is an absolute necessity in any urban environment. If several of your neighbors have antennas, you can check with them to see if they are experiencing any interference problems.

Assembling The Dish

The dish antenna should come with a detailed set of instructions covering all the essential construction information. When you first receive the dish, check to see that all parts listed in the manual are present and accounted for. Read over the instructions to see what tools and other materials will be required. If assistance during assembly is recommended, arrange to have a friend or two available to help lift the dish onto the pole.

On the evening prior to assembly, check the local weather forecast to ensure that your efforts will not be interrupted by rain or heavy winds. Begin assembly early in the day to allow enough time to complete the project.

Take care during the assembly to ensure that you get the most accurate curve possible. Many popular dishes today are comprised of four sectional preassembled panels called "quads" which bolt easily together. You'll want to have the dish fully assembled and anchored before leaving it unattended.

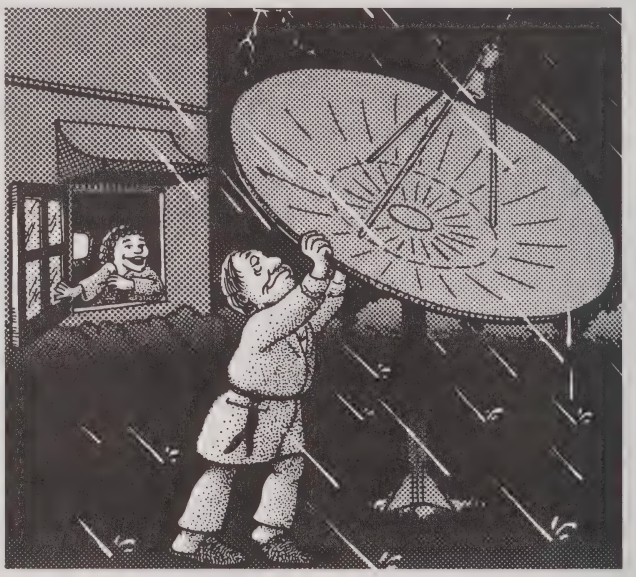


Fig.7-10. "Basil! I told you to start putting that together earlier in the day. Hurry up or we're going to miss the start of Shogun."

Mount Alignment

The pivotal axis of a polar mount antenna must be accurately aligned to true north. Even when this alignment is done with an engineer's transit,

slight inaccuracies in the measurement may result, causing uneven tracking of the geostationary satellites. Corrected compass readings may be even further off the mark. While compass readings may be useful during the site survey for locating a clear view of the satellites, the real test of your polar mount's alignment is the video reception which you obtain.

When mounting the antenna onto the pole, snug the bolts just enough to hold the antenna in place. Tightening the bolts down firmly on the pole should be one of the very last things you do, and should be done only after you have gotten the dish to track the satellites properly. Tightening beforehand can dimple the pipe, making it more difficult to make subtle adjustments in alignment.

Mounting the LNB and Feedhorn

Extreme care should be taken when bolting the LNB to the feedhorn. Do not touch the probe inside the mouth of the LNB. This probe can be adversely affected by grease or dirt. Also make sure that the neoprene gasket that goes between the feedhorn's flange and the mouth of the LNB is "seated" properly in the groove provided. Otherwise, moisture can seep into this opening and disrupt your reception.

The center of the feedhorn must be supported exactly at the focal point of the dish. The focal distance between the center of the dish and the mouth of the feedhorn will vary between different models of antennas, depending on whether the manufacturer has used a deep or shallow dish design. The exact distance will be provided in the instructions.

There are two feed support styles available, one of which will be supplied with your antenna. A "button hook" support, sometimes called an LNB tube, is a single piece of tubing which extends from the center of the dish outward. The button hook support, which is curved so that it resembles a hook, allows the feed to be mounted looking back at the center of the dish. Guy wire kits are available for button hook supports that will provide the additional stability required for reception of both C- and Ku-band signals. Ku-band signals are much higher in frequency and therefore are beamed Earthward in much smaller wave lengths. Consequently, the antenna curvature and location of the feed for Ku-band reception must be much more precise than what C-band systems commonly require.

We recommend that you check to ensure that the feed is centered over the dish by measuring from the lip of the antenna to the edge of the feedhorn's opening at four equally spaced intervals around the antenna's rim. This is especially important if you are using guy wires to anchor the button hook support. If the feed is centered, these measurements will all be equal. If they

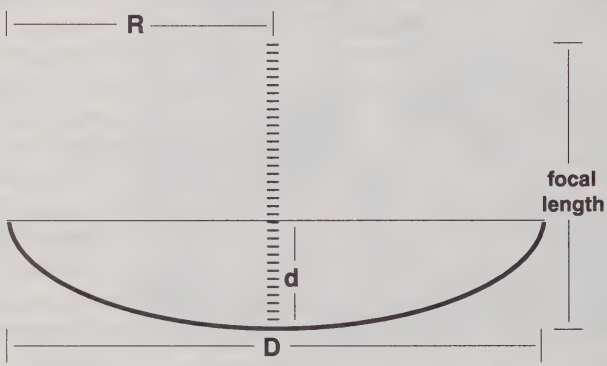
are not equal, you will have to adjust the tension of the guy wires until the feed is properly centered.

The second type of feed support uses a multi-legged structure to hold the feedhorn and LNB (or LNBs for dual-band systems). These are made up of three ("tri-pod") or four ("quad") straight, equal length pieces of aluminum or steel. Quad supports are inherently more stable than button hook supports, offering better Ku-band reception. When mounted at the recommended locations on the antenna's surface, these supports should accurately position the feed at the correct focal length: the distance between the center of the dish and the opening of the feedhorn. The correct focal length for your dish is provided in the manufacturer's assembly manual.

Once your system is up and running, you can fine tune the focal length for its optimum position by moving the feed in and out in small increments while watching the receiver's signal strength meter. This is easier to do with a button hook than a quad support. This adjustment is particularly important if you are having trouble receiving Ku-band satellite signals.

You can compute the focal length if you know the diameter of the dish along with its f/D ratio. Focal length = the antenna diameter times the f/D ratio. For example, the focal length of a 10 foot antenna with an f/D ratio of .45 equals 10 x .45 = 4.5 feet (54 inches).

To determine the antenna's diameter, measure across the surface of the dish from one side to the other. The radius equals one half the diameter. The



You also can compute the focal length (f) of any parabolic antenna by using either of the following formulas:
$f = R^2/4d$ or $f = D^2/16d$, where R^2 = radius of the antenna in inches, squared; D^2 = diameter of the antenna in inches, squared; d = depth of antenna in inches.

Fig.7-11. Determining the focal length of any dish.

depth of the dish is the distance from the center of the dish to the plane of the rim. Stretch a string across the antenna's rim so that it crosses in the center of the dish. The depth will be the distance from the antenna's center to the string.

Many feeds today have adjustable scalar rings. These feeds can be broken down into two parts: a round flat "scalar" plate with concentric circles on its surface and the wave guide onto which the LNB is mounted. This wave guide (technically referred to as an "orthomode coupler") fits into the center of the scalar plate and can be adjusted inward and outward.

The distance that the wave guide extends beyond the surface of the scalar plate must be set to correspond to the f/D ratio of the antenna. Consult with the manufacturer's assembly directions or use the formula provided above to determine the correct f/D ratio of your antenna.

The wave guide may be marked to indicate the various f/D ratio settings. Alternatively, the feedhorn may come with an adjustment gauge for setting the correct location of the scalar rings.

Another thing to check: the plane of the feed opening should be the same as the plane of the rim of the dish. You can use your inclinometer to check to be sure that both the feed opening and the antenna's rim are parallel with each other.

Running the Cable

In most cases it will take three sets of wires to hook up your system: the coaxial cable from the LNB to the receiver, a three conductor wire from the servo motor of the feedhorn to the servo motor control on the back of the receiver, and a four or five conductor wire from the actuator motor at the antenna to the control terminals on the back of the receiver or actuator power supply. We will examine each of these wires in detail in the following sections.

The best way to acquire these wires is to purchase an all-in-one direct burial satellite cable from your retailer at the time you purchase your system. Bury the cable in a trench that lies below the frost line and you are ready to go.

Make sure that you purchase more than enough cable to complete the run all the way from the feedhorn on the antenna, down the pole, in the ground from the pole to the house, up the wall, through the attic, and down an interior wall (which is not always, but often times, the case), while leaving enough left over to easily reach to the back of the receiver. It is possible, but not desirable, to splice an extra few feet onto your cable if you do come up short or decide to rearrange the furniture in the future.

Before connecting all of these cables, however, self-installers should consider temporarily using a short piece to connect the receiver and TV to the outdoor electronics right out at the dish. This method for aligning the dish allows you to make tracking adjustments to the antenna while viewing TV signals and watching the receiver's signal level indicator. If you are going to have a technician during the final stages of the installation he will have a portable meter to use at the dish. Two people also can talk back and forth via walkie talkie or portable phone while one makes adjustments to the dish and the other keeps an eye on the quality of the reception.

Direct burial satellite cable is available containing either one or two coaxial lines. The direct burial cable with two coaxial lines is essential if you intend to use either a hybrid feed (which requires one C-band and one Ku-band LNB) or a dual C-band feed (which requires two C-band LNBs). We recommend that you purchase the direct burial cable with two coaxial lines even if you initially intend to use only a single LNB. The spare coaxial line will then be in place in the event that you ever want to upgrade your system or encounter problems with the primary coaxial line.

If you intend to have more than two LNBs at the dish, you will need to run separate coaxial lines for each of them. For example, multiple receiver systems with feedhorns which support two C-band and one Ku-band LNB or two C-band and two Ku-band LNBs will need multiple coaxial lines. We go into detail about multiple receiver systems in chapter 11.

Coaxial Cable and Connectors

You already may be familiar with the cable used for connecting your TV set to the home's master antenna system, a shielded wire called coax (koh-axe, from coaxial). Coax is made up of an inner wire covered with a plastic or foam sheath, and an outer mesh that is in turn surrounded by an outer plastic covering.

A single coaxial cable is used to carry the signal from the outdoor electronics to the indoor receiver. A shorter piece of coax also is used to connect the receiver to the antenna input on the TV. If the programming is to be viewed on other TV sets, the coax cable will first go to a splitter and then on to the various TVs.

A unique type of cable TV connector, called an 'F' connector, is crimped onto each end of the coaxial cable. It mates

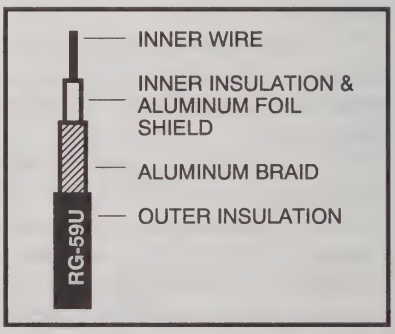


Fig.7-12. Coaxial cable.

with complementary connectors on the LNB and indoor receiver. Your local electronic supply house can provide you with the special tool used to crimp 'F' connectors onto the cable. Or you can purchase standard lengths of cable with the connectors already installed.

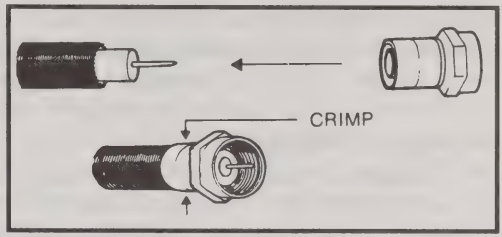


Fig.7-13. F Connectors.

When screwing an F connector onto mating connectors on the back of the receiver or LNB, you should take care to avoid bending or breaking the cable's inner conductor, thereby shorting out the connection. There also are right-angle F connectors which can be used whenever space limitations prevent a straight-on connection.

The block IF signal coming from the LNB is no longer a microwave signal. That's why a relatively inexpensive and readily available coaxial cable of small diameter can be used to carry the signal to the indoor receiver. The type of cable commonly used in satellite TV installations has a characteristic impedance rating of 75 ohms. The type of cable used by CB radios and other two-way radio equipment has a characteristic impedance rating of 50 ohms and is not suitable for satellite TV use. Be sure that the cable you buy is 75-ohm coax.

There are several different kinds of 75 ohm coaxial cable available. RG-59U coax can be used to span distances of up to 100 feet. For longer lengths, lower loss RG-6 or RG-11 are used. Direct burial satellite cable contains one or two spans of RG-6. Since RG-6 is slightly larger in diameter than RG-59, it also requires a slightly larger F connector. To span distances of several hundred feet, special UHF line amplifiers with +10 or +20 dB gain also may be necessary to compensate for the amount of signal loss or attenuation that occurs as the signal passes along the length of cable.

The power required to operate the LNB (and any line amps if used) is supplied by the receiver and sent to the LNB via the center conductor of the coax cable. The power stays on even if the receiver is turned off. This keeps the LNB at a more consistent temperature and prevents moisture from condensing inside it.

The receiver should be unplugged from the a.c. wall receptacle before connecting or disconnecting the coax cable from the LNB or the receiver. This eliminates the chance of a short circuit across the coaxial connections.

The connection to the LNB also should be weatherproofed to keep moisture out. This can be done by flooding the connector with a dielectric silicone

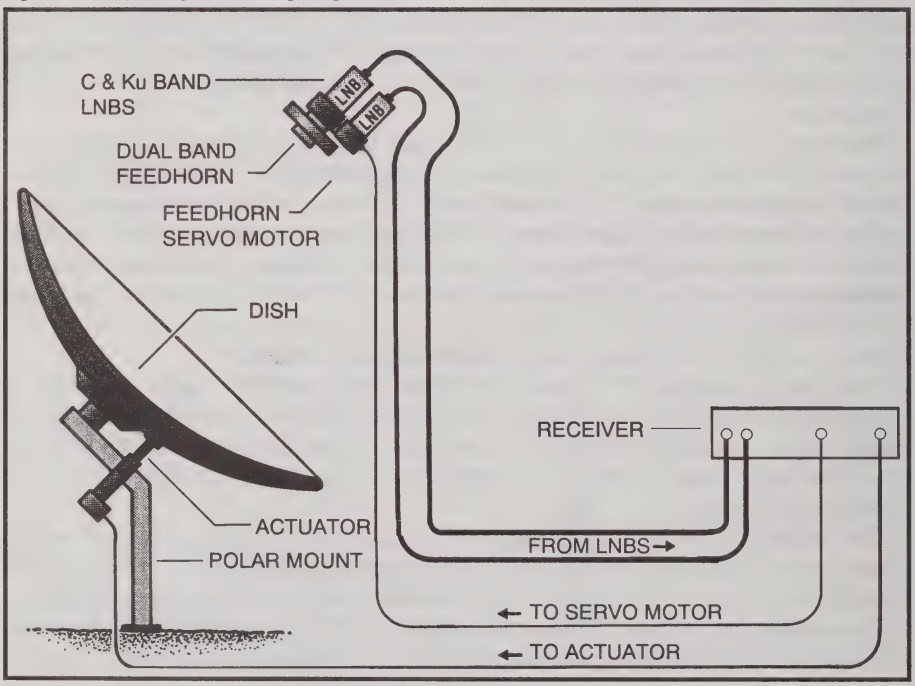
sealer or wrapping the connection with a sticky waterproof compound such as Coax-Seal. It is also a good idea to use a plastic LNB cover to give your outdoor electronic components added protection from the elements.

Wiring the Feedhorn

The feedhorn line of the direct burial cable is comprised of three color-coded 22 gauge (or larger) stranded wires. These wires also are shielded and jacketed. The three wires provide power, pulse, and ground connections for the feedhorn. Each of these wires connects to corresponding terminals on the back of the receiver. The wires are color-coded to help identify them when connecting to the three servo motor wires at the feed (usually red for power, white for pulse, and black for ground).

A stranded wire is used because it is more flexible and won't break as easily as a solid wire. The shield, an aluminum foil wrapped around all three wires, keeps impulse noises from entering the line and giving false pulses to the receiver. The receiver uses pulses to keep track of the position of the

Fig.7-14. Satellite system wiring diagram.



feedhorn's pick-up probe. You therefore can adjust, or "skew", the position of the probe and program the optimum polarization for any given satellite transponder into memory.

The feedhorn's servo motor rotates the pick-up probe, which swings back and forth while switching between the horizontally and vertically polarized transponders (odd and even channels). Keep in mind that there are limits to the pick-up probe's clockwise and counter-clockwise movements. The feedhorn must be aligned on the antenna so that the probe can swing the 90 degrees from horizontal to vertical (or left-hand to right-hand circular) polarization without reaching the limits of its travel. Several manufacturers include a directional guide with their feedhorns to show the proper alignment of the feed when installed on the dish. If you find that you cannot skew the probe beyond a good picture on both the odd and even channels on all satellites, you will need to loosen the clamp that holds the feed onto its support and physically rotate the feedhorn until it is possible to do so.

Wiring The Actuator

The direct burial cable's actuator line is comprised of five stranded wires. Two 14 or 16 gauge stranded wires are used to power the motor and three color-coded 22 gauge shielded wires connect to the sensor. These actuator wires should be connected to the appropriate terminals on the back of the receiver (or a separate actuator power supply).

Like the servo motor wires, the three shielded motor sensor wires also provide power, pulse, and ground. The vast majority of actuator motors do not require power to be hooked to the sensor. Look inside the actuator housing. If there are only two wires connected to the sensor, then hook up pulse and ground to their respective terminals. If there are three wires connected to the sensor, then hook the 5 volts from the receiver to the red wire on the actuator's sensor, and pulse and ground interchangeably to the other two sensor wires.

The two large stranded wires connect to the large wire terminals at the actuator motor and to the motor wire "1" and "2" terminals on the back of the receiver or power supply. Now try to move the dish to the east or west; if the dish moves in the direction opposite to the one intended, reverse the wires connected to the motor wire "1" and "2" terminals.

Some satellite receivers have an external power supply that puts the large transformer outside of the receiver chassis. This reduces the receiver's size as well as its operating temperature. The power supply is actually a large transformer that turns 110 or 220 volts a.c. into 24 to 36 volts d.c. to power the actuator's d.c. motor.

This outboard power supply can be placed behind the TV set or at some other out of the way place. Moreover, in a two receiver system you will not need to purchase a second power supply because only one receiver can control the antenna's position. The receiver with the power supply is then called the "master" while any additional receivers are called "slave" units.

Water intrusion can be a big problem with actuator motors. Be sure to run the wires through the rubber grommet supplied with the actuator to seal off the opening. Also mount the motor so the drain holes are on the bottom to allow any moisture to run out.

Grounding the System

If your home's a.c. electrical ground is close to the dish, use a No. 10 AWG or larger solid copper ground wire to connect it to the pipe supporting the antenna. If your dish is physically removed from your home, pound in a separate grounding rod and use a No. 10 AWG or larger solid copper ground wire to connect the pole to it. You should also install an antenna discharge unit or ground block, a passive electrical device that connects in-line between your outdoor electronics and the indoor satellite receiver. To work properly, the ground block should be connected to a ground rod or to the a.c. ground of the house. For added protection prior to a lightning storm—or whenever your system is left unattended and unused for long periods of time—you should **first unplug the satellite receiver from the a.c. wall outlet and then disconnect the incoming coaxial cable(s) from the IF input of the receiver.** After the storm has passed, **reconnect the coaxial cable to the receiver's IF input port before plugging the receiver back into the a.c. wall outlet.** This will help prevent damage due to lightning or related power surges.

There are quick disconnect adapters available which allow you to quickly and easily disconnect all of your indoor components from the rest of the system. You also should use a surge protector on your a.c. line to prevent voltage surges or spikes from setting your receiver aglow.

Attaching the Actuator to the Dish

Your dish will have either a horizon to horizon mount or a mount which requires an actuator arm. For "horizon" mounts, the motorized housing will attach directly to a mating flange on the mount. Since there are several steps involved in installing motorized actuator arms we will describe these steps in detail. The principles related to setting the motor's programmable limits will be the same for either style mount.

Before you begin to install your actuator arm, prop the dish up a few

degrees with a block of wood or something else which won't damage the antenna. Attach the arm to the dish and the mount as indicated in the manufacturer's assembly directions. The arm attaches on the west side of the dish on systems located in eastern Asia and on the east side of the dish on systems located in western Asia. If you are somewhere in the middle of the continent, observe how they are mounted on existing systems in your area or ask your satellite retailer which is the correct method for you.

Refer to the Universal Azimuth-Elevation Look Angle chart on page 86 to find the elevation angle for the satellite that is furthest to the west and furthest to the east of your location. Before tightening the clamp which goes around the arm, use the inclinometer to read the elevation angle of the dish. The arm is at its most retracted position when first installed. You will want the antenna pointed just below the lowest satellite at your location when the arm is in this position. Prop the antenna at this elevation angle and then snug the clamp on the arm just enough to hold it in place.

Dish Alignment Settings

You have now completed the basic construction of the dish and are eagerly anticipating your first pictures from space. To fine tune those pictures and get your dish to track, you, or someone you can communicate with, will need to watch the TV screen while adjustments are being made to the antenna. You may even want to bring the TV and receiver out to the dish. If you have purchased a dual-band receiver, be sure that it is set to C-band before proceeding.

At this point, it is best to connect the satellite receiver directly to the TV and not through a VCR, video switcher, splitter, or any other device. The appropriate receiver output connector will be labeled "To TV" or "RF OUT". On most receivers, the output signal can be switched between two VHF or UHF channels. Select the VHF or UHF channel which is not in use in your area. Tune the TV set to receive the selected VHF or UHF channel.

At this point it is a good idea to follow the step-by-step procedures provided in the owner's manual. In most cases, the receiver also will prompt you with instructions that are displayed on the TV screen or on the receiver's front panel.

You first may be instructed to "Set East and West Limits". This is referring to the limits of travel for the actuator arm or horizon drive. Although the motor has a slip clutch to prevent damage when the arm is extended or retracted completely, it is best to set the receiver's programmable limits at positions before the arm reaches these points. Many motors come with built-in limit switches which will shut off the motor at designated points.

Setting the east and west programmable limits. The receiver's programmable limits need to be set to stop the travel of the arm or horizon drive before the built-in limit switches are engaged or before the drive's physical limits are reached. If the arm does reach its full length or is retracted completely the motor's slip clutch will start making loud "clicks". Stop immediately. If the arm becomes stuck in this position, take the motor off and insert the blade of a heavy screwdriver in the slot where the motor engages the arm. Turn the screw driver just enough to loosen the arm, then put the motor back in place.

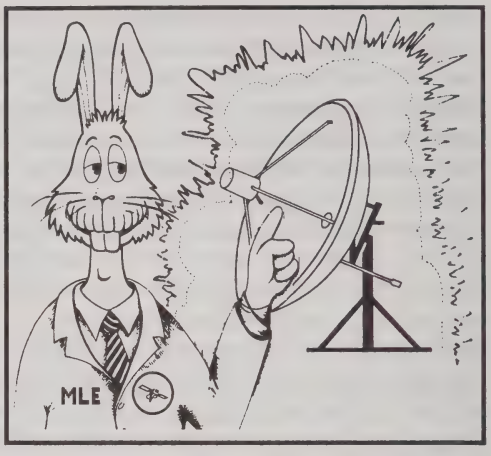


Fig.7-15. "Don't forget to program the limits before taking your new dish out for a test drive."

The idea here is to set the limits so they are just past the last satellite at either end of the satellite arc but before the mechanical limits of the drive. You can determine the elevation angles for the last satellite to the east and west by using the chart previously provided on page 86.

You may find that, after you have started to receive satellite pictures, you have not left yourself enough room to jog the antenna past the lower or upper satellite (thus making sure you have the best possible picture). In this case you may have to loosen the clamp on the arm and physically adjust it a little, after which you may have to reprogram the limits. An 18-inch arm should be long enough for any 10-foot (3m) or smaller antenna and also most 12-foot (3.7m) antennas. Longer arms are available for larger dishes.

Check to see if you need to reset the limits before programming in the locations of the individual satellites. Otherwise you may delete programming information that you entered into memory prior to resetting the limits.

Setting the polar axis elevation of the dish. Extend the drive until the dish is looking at the highest point in the sky (arc zenith). Set the inclinometer onto the polar axis of the dish. Adjust the polar axis of the mount to the correct elevation angle for your location.

Setting the declination. Declination is the offset angle between the polar axis of the mount and the rim of the dish which permits the antenna to precisely track the Clarke Orbit. The declination angle at any site is

determined by the latitude at that location. The declination setting must be adjusted to the figure supplied by the manufacturer for your specific site. If you need to compute the declination you can find out the correct value by using the following chart on page 102.

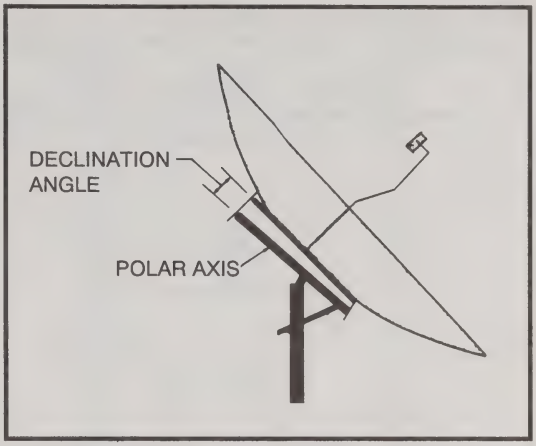


Fig.7-16. Antenna declination and elevation angles.

With a modified polar mount antenna, correct tracking of the total Clarke Orbit is only possible when the declination has been properly set. Set the inclinometer on the back plate of the antenna (same plane as the rim of the dish). Using the declination adjustments on the mount, set the antenna for an elevation angle that is equal to the polar axis angle plus the number of degrees of declination for your area. The dish should be looking down slightly from the angle of the mount.

Tracking Procedures

Now is the time to begin tracking the satellites and programming their positions into memory. This is not difficult now that you have everything set. When moving the dish to the east or west, the dish's look angle should now follow a curve similar to that of the Clarke Orbit.

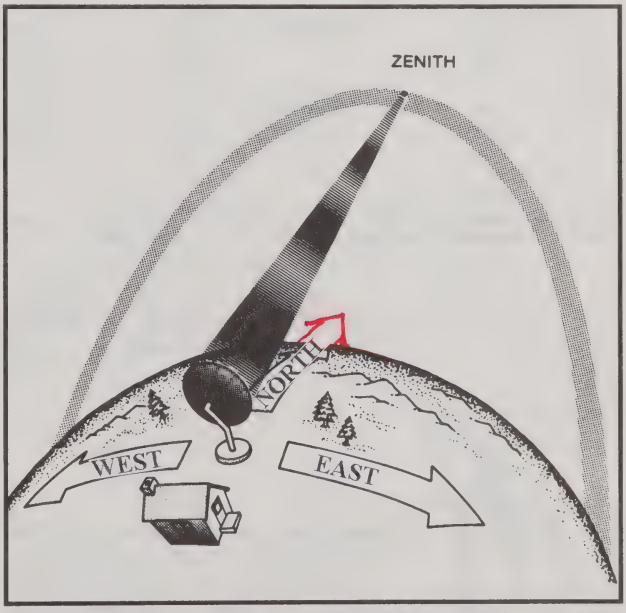


Fig.7-17. Arc Zenith (for locations north of the equator).

Fig.7-17. Declination offset angles.

N. or S LATITUDE	NEARBY CITY/REGION	POLAR AXIS ANGLE	ARC ZENITH	DECLINATION ANGLE
43	Vladivostok	43.72	49.61	5.89
41		41.71	47.38	5.67
40	Beijing, China	40.71	46.27	5.56
39		39.70	45.15	5.45
37	Seoul, Korea	37.69	42.90	5.21
35	Tokyo, Japan	35.68	40.65	4.97
33		33.67	38.38	4.71
31	Shanghai	31.64	36.11	4.47
30		30.63	34.96	4.33
29		29.62	33.82	4.20
28		28.61	32.68	4.07
25	Karatchi, PK	25.57	29.23	3.66
20	Haikou, China	20.47	23.45	2.98
15	Manila, PH	15.37	17.62	2.25
10	HCM City, VN	10.26	11.77	1.51
05	Brunei	05.13	05.89	0.76
Equator		0	0	0
05		05.13	05.89	0.76
10	Port Moresby	10.26	11.77	1.51
15		15.37	17.62	2.25
20		20.47	23.45	2.98
25		25.57	29.23	3.66
28	Brisbane, Aust.	28.61	32.68	4.07
29		29.62	33.82	4.20
30		30.63	34.96	4.33
31	Perth, Aust.	31.64	36.11	4.47
33	Sydney, Aust.	33.67	38.38	4.71
37	Auckland, NZ	37.69	42.90	5.21
40		40.71	46.27	5.56

(IN DEGREES)

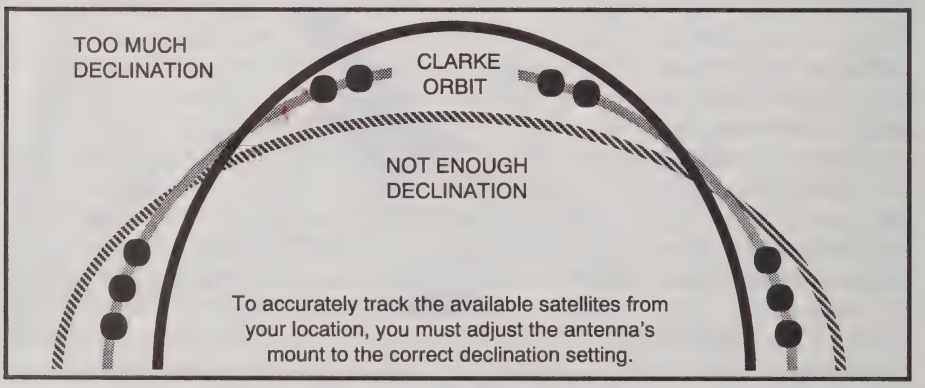


Fig.7-18. Effects of declination adjustment.

You may have a satellite receiver that was designed to find and program the satellites on its own. However, even these "smart" receivers will require you to find and identify one upper and one lower satellite. There also are automatic dish peaking and polarity peaking features on some receivers. If you choose to use these auto features, first follow the steps below to get your dish to track the Clarke Orbit. Once you are confident that you are receiving your best signal on a lower and upper satellite and have programmed them into the receiver, you are ready to turn on the auto program feature.

The accuracy of these auto features primarily depends on which brand of receiver you have purchased. Some receivers occasionally miss a satellite or two and you often find that you can peak the position of the dish and polarity better manually. We recommend, especially during the initial installation, that you turn these features off.

Many receivers have a scanning feature that is handy for locating satellites. These receivers scan repeatedly from channels one through twenty-four at a rapid pace, providing you with glimpses of the active transponders. Channels will flash by on your TV screen as you move the dish past a satellite. You can go back to where the flashes occurred, turn off the scan feature, and identify the satellite by comparing the programming to a recent satellite TV guide's listings. Some satellites only carry a few active transponders. Without the scan feature, you would need to select an active transponder and tune to the correct polarization before you could find the satellite.

Preview the sections in your receiver manual on dish set-up and programming. Also read through these next steps to get familiar with the overall procedure you are about to perform. Finally, initiate each of the steps below.

Inclinometer readings for the satellite look angles (the elevations of the satellites available in your area) should be taken on the back plate of the antenna or on a surface parallel to the plane of the rim of the dish.

1.) Determine the elevation of the lowest satellite available from your location and move the dish until the inclinometer registers that elevation.

2.) Engage the receiver's scan feature or set the receiver to a channel which should have programming on it. A 24 hour service, even if it is scrambled, would be a good choice. Refer to a current satellite program guide to find a suitable selection.

3.) Push the dish to the right or left so that it rotates on the pole until you see a flash of video on your TV screen. Turn off the scan and go through the channels until you find video.

If the video seems to zip off the screen as soon as you stop on the channel try changing the receiver's polarization format. That is, if you have your odd

channels set for vertical polarization and your evens for horizontal, change the format to odds-horizontal, evens-vertical. You may not even know the present polarization format for your system. A change in format changes the relationship of the feedhorn's pick-up probe by 90 degrees. If changing the format keeps the video on the screen, then it has to be the correct setting for that satellite on your system.

Select the best skew setting for the odd and even channels. The skew and format buttons are found either on the front of the receiver or on the remote control. Many receivers with on-screen graphics require you to choose these functions on the menu.

Most receivers have a LED signal level indicator on the front panel or a digital level indicator presented by on-screen graphics. The level indicator provides a better reading of peak satellite perfomance in contrast to just viewing the picture on the TV screen.

4.) For locating satellites in the lower section of the Clarke Orbit, push the dish right and left on the pole and move the drive east and west in slight increments until you are satisfied you have the strongest signal. Then snug the mount's bolts onto the pole so that the dish won't rotate. Do not tighten them down firmly yet, however. Note the numerical reading provided on the receiver's front panel or on-screen display that corresponds to dish position at this location. This is a relative number that changes as the dish moves.

5.) Move the dish east or west until you reach arc zenith for your location. Select an active transponder for the satellite closest to the east or west of arc zenith or turn the scan control on. Now move the dish in the direction of the nearest satellite. If all the settings have been done right you should not have a problem finding it.

6.) For locating satellites that are in the upper section of the Clarke Orbit, jog the actuator drive east and west and adjust the elevation bracket (on the mount of the dish) up and down slightly. You should not have to move the elevation setting very much because you already have pre-set it for your location. The rule of thumb here is:

Rotate the dish on the pole and use the actuator to receive lower satellites, but do not rotate the dish on the pole to receive upper satellites. Adjust the elevation of the dish and use the actuator to receive upper satellites, but do not adjust the elevation to receive lower satellites.

7.) Fine tune your tracking by repeating these steps until the satellites in both the upper and lower sections of the Clarke Orbit appear at their maximum signal strength without requiring any further adjustments. If this cannot be done, you have probably made a miscalculation in the elevation or declination settings. Once you have the dish tracking properly, firmly

snug the bolts that secure the mount onto the pipe. Placing a bolt all the way through the pipe may be desirable in high wind areas. Mark the pole and the mount for later reference.

The Final Connection

The final connection is from your satellite receiver to your TV set. We mentioned above that you can hook up a coaxial cable directly from the "To TV" ("RF Out") output of the receiver to the "Antenna" input of the TV set. Your local antenna wire, which formerly was connected directly to the TV set, should now be connected to the "Antenna" input on the back of the receiver. To watch local channels, turn the satellite receiver off and the local channels will automatically appear on their respective channels on the TV.

If your satellite receiver does not have this feature, you will need to purchase an A/B switch from your local satellite or electronics store. Both the satellite receiver and local antenna connect to the "A" and "B" input ports on this switch, while the single output port connects to the antenna input on the TV. This switch will have to be changed manually whenever you want to go from one to the other. You also will need to use an external A/B switch if a second TV is connected to the satellite receiver and one person wants to watch local TV while the other is watching a satellite TV program.

There are other options when it comes to connecting the satellite system to your TV set or home theater system. There are video and stereo audio outputs on the back of your receiver. These can be connected directly to a TV monitor or to a VCR for recording programs. Whenever a VCR is part of the overall entertainment system, the

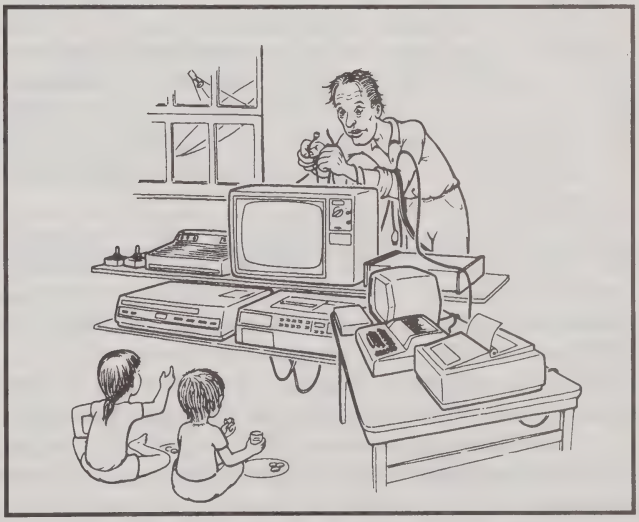


Fig.7-20. "...after that we want to see cartoons and play a video game, then we want to watch the MTV satellite, and don't forget Mom wants to record a movie on STAR Plus at four."

output of the VCR must be connected to the TV set and the local antenna is usually also connected to the "Antenna" input of the VCR.

The satellite receiver's stereo audio outputs can be connected directly to the stereo inputs of the TV set or to the auxiliary inputs of your stereo system's audio amplifier or tuner. For hooking up more than one TV set in the home to the satellite TV system, see chapter 10.

Coping With Video Standards

The international community uses several techniques to encode the picture and color components of video. On Asiasat alone, satellite TV viewers will encounter all three of the basic color encoding systems being used around the world today: NTSC, PAL, and SECAM. Reception of all three video standards by your satellite TV system will require the use of a multistandard monitor or a special VCR that transcodes the TV transmissions from their original standard to one that can be displayed by your regular TV set.

NTSC. Named after the U.S. National Television Standards Committee which selected this method of color coding back in 1953, NTSC utilizes a separate 3.58 MHz "chroma" subcarrier to contain the color information. NTSC is used for all of STAR TV's Northern Beam broadcasts. The countries within the region using NTSC include Japan, South Korea, Taiwan, and the Philippines.

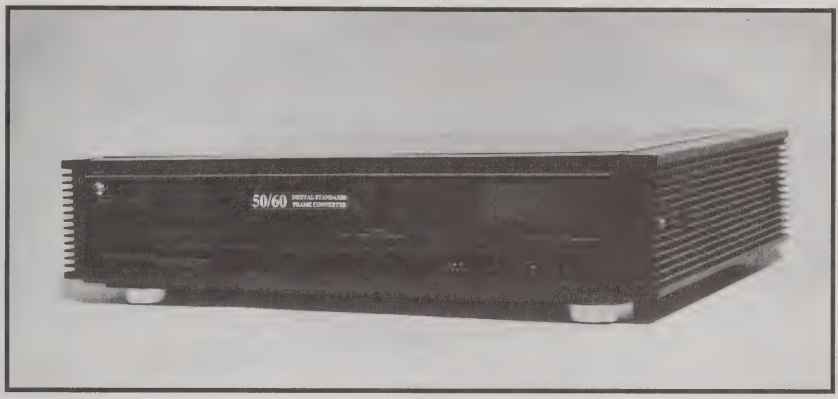
SECAM. The French system is called SECAM (for Sequence a Memoire). This system FM modulates the color information onto two subcarriers which are then recombined at the television set. Within the region, SECAM is currently used for satellite broadcasting by member countries of the Commonwealth of Independent States (formerly the Soviet Union), Vietnam, and Mongolia.

PAL. A third system, developed by the Germans, is called PAL (for Phase Alteration by Line). This system is used to transmit all of STAR TV's Southern Beam broadcasts. The countries within the region using PAL for satellite broadcasting include Australia, Indonesia, Malaysia, New Zealand, Thailand, and the People's Republic of China.

Multi-standard monitors and receivers are available so that you can view overseas satellite TV signals in full color. Some models will automatically detect and display the correct standard. Both Instant Replay and Panasonic offer special VCRs that will convert PAL, SECAM, and NTSC signals so that you can record them for later viewing, or view them live on any TV set in your home. We would recommend one of these for any first-class international earth station installation.

You also can receive a black and white picture from any standard on any

Fig.7-21. 50/60 Image Translator VCR. (Courtesy Instant Replay.)



Standard Features: *Full featured VCR with tuner, timer, and wireless remote. The 50/60 VCR also plays NTSC, PAL, and SECAM tapes on all American TVs or monitors.*
Special Features: *New technology allows the 50/60 to produce 525 line 60 Hz NTSC from 625 line 50 Hz PAL/SECAM. The 50/60 VCR's digital frame standards converter module produces an output signal that is compatible with all NTSC TVs and monitors. There are no requirements for a vertical hold control and no problems with the picture rolling.*
What's more, this converted signal is recordable. The 50/60's digital frame standards converter is actually a true standards converter. Both the standard NTSC signal and the converted output are available as composite video and RF.
Optional Features: *S-VHS models also are available.*
Availability: *From Instant Replay, 2601 S. Bayshore Drive, Suite 1050, Coconut Grove, FL 33133 (Tel: 305-854-8777.) Prices begin at US$ 995.00*

television. When receiving 625-line video on an NTSC monitor, first readjust the set's vertical hold control to stop the picture from "rolling". Then readjust the vertical linearity control to reduce the picture's height so that the 625-line picture will fit on the screen. The linearity control may be on the back of your set. If this adjustment requires the use of a screwdriver, be sure to use an insulated tool to prevent the possibility of shock.

Before making the linearity adjustment, the top and bottom of the picture appears cut off and everything looks skinnier than it should be. For someone with a 625-line set, the vertical linearity would be adjusted so that the video fills the entire screen. Unadjusted, 525-line video on a 625-line set looks compressed, with no picture present at the very top and bottom of the screen.

Fig.7-22. Panasonic AG-W1 World TV Broadcast VCR. (Courtesy Panasonic.)

Switchable Video Deemphasis. Every satellite TV receiver has a deemphasis filter which follows the demodulator stage; slightly different components values are necessary for 525-line video than for 625-line video. If this circuit is not modified, there will be a barely perceptible degradation of the video, more noticeable on marginal signals. Use of the incorrect deemphasis network also can pose problems when recording satellite TV programs with your VCR or interfere with the remodulation schemes used in SMATV or CATV RF signal distribution systems. (See chapter 10 for more information on SMATV and CATV distribution systems.) Manufacturers of receivers for the Asian marketplace provide switchable deemphasis circuits within their products.

Chapter 8
Scrambling, Digital Compression, & High Definition Television (HDTV)

Scrambling is an electronic means of rendering the video and audio reception of a program unintelligible except to those stations which are authorized to reassemble the signals; all other stations intercepting the scrambled program will encounter distorted video. Program suppliers spend huge sums of money to produce programs or to obtain the rights to show someone else's productions, and therefore have a right to be fairly compensated for the use of their material. On the other hand, people should have an equal right of access to any program distributed via the public air waves for which they are willing to pay a reasonable rate. This is especially relevant if they live in an area where there is no other means available to view the programs except via their home satellite TV systems. What scrambling systems do is to provide the program services with security against unauthorized reception as well as a reliable way to bill their subscribers.

Because Asiasat's STAR TV services are advertiser-supported, they are transmitted in the clear and free-of-charge. National broadcast networks from various countries within the region also are unscrambled. However, other programmers in the region—such as CNN International, ESPN, and the American Forces Radio Television Service (AFRTS)—have scrambled their services to prevent unauthorized reception.

At the time of writing, reception of CNN and ESPN was limited to authorized broadcast and cable TV outlets within the region. Both CNN and ESPN, however, have indicated a willingness to eventually provide direct-to-home reception of their services in Asia, once local governments have approved their entries into the marketplace and billing systems have been established.

In Japan, six new programmers recently received permission from the Japanese government to begin direct-to-home transmissions via the JCSat and Superbird satellites. All of these new satellite TV services will be scrambled. Moreover, the Japan Satellite Broadcast (JSB) service transmitted by a Japanese DBS satellite is encrypted as well. Descramblers for these services are readily available to Japanese satellite TV viewers.

In Australia, the ABC national television network and regional TV networks such as Golden West, Queensland Satellite TV, Imparja, and the Specialized Broadcast Service, are available to satellite TV viewers equipped with an integrated receiver/descrambler or IRD.

Integrating The Descramblers

Sometime in the not-too-distant future, scrambled program services will become available to satellite dish owners on the continent of Asia. Therefore, it is important to know a few facts about how these integrated receiver/descramblers (IRDs) will operate.

IRDs have been available for the U.S. and Australian marketplaces for more than five years. In 1991, IRDs also became available in Europe for reception of medium and high powered satellite TV signals.

With the development of the "integrated receiver descrambler" (IRD), the descrambler has been rendered transparent to the operator. There are several other compelling reasons for placing the descrambler inside the receiver. Since the IRD's microprocessor is in charge of all system functions, the operator can use one handheld keypad to control the entire system, including the descrambler module.

Due to the digital audio capabilities of the descrambler module, the latest IRDs can deliver superb stereo audio performance from the scrambled program services. Audiophiles also will be delighted to learn that a great number of stereo audio subcarrier services can be stored in memory and recalled at the touch of a button.

Fig.8-1. A B-MAC Integrated Receiver/Descrambler (Courtesy Scientific-Atlanta.)

The B-MAC Scrambling System

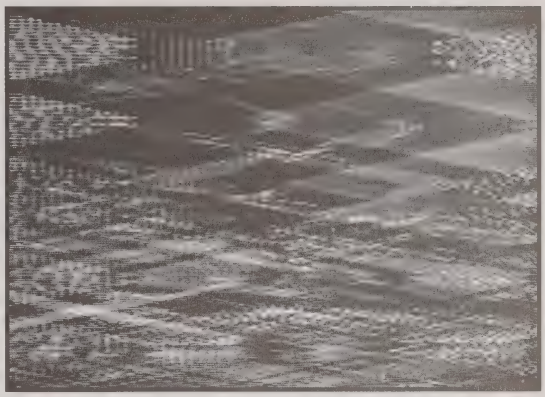


Fig.8-2. B-MAC encryption. (Courtesy Scientific-Atlanta.)

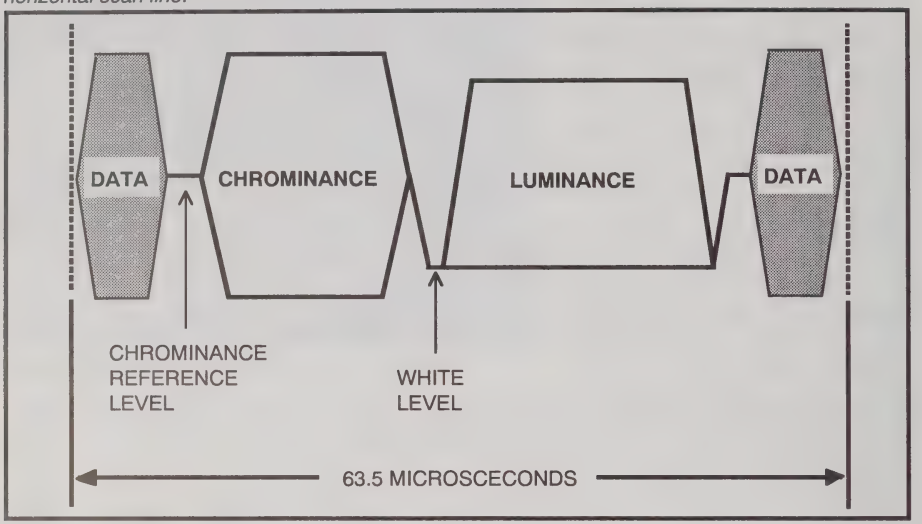
Scientific Atlanta's B-MAC (Multiplexed Analog Component--Type B) video encryption system integrates video, audio, data, and teletext into a single TV signal. The B-MAC scrambling system is presently being used by CNN International, ESPN, and the American Forces Radio Television Service (AFRTS) to distribute their signals to authorized outlets in Asia, the Middle East, and the South Pacific. All direct-to-home Australian satellite TV services also use the B-MAC scrambling system.

While B-MAC does supply these above-mentioned services with relatively secure and addressable communications signals, it is not just another scrambling system. B-MAC provides the additional benefit of increased signal performance at low carrier-to-noise levels when compared to an NTSC, PAL, or SECAM video transmission. B-MAC's improvements over NTSC, for example, equate to an economic savings for users, since they can use smaller, less expensive ground stations on the receive portion of the network. B-MAC also can simultaneously transport up to six digital audio signals, one utility data channel and teletext—all by means of a single satellite transponder.

Instead of simultaneously transmitting the chrominance (color) and luminance (brightness) information, B-MAC sequentially transmits the color information in one-third the active scanning time of each frame and the monochrome information in two-thirds the active scanning time. This prevents the chrominance and luminance signals from interacting with each other, thereby introducing unwanted distortions or "artifacts" into the video. The video performance is further improved by the use of a digital sync pulse.

The B-MAC video's vertical blanking interval contains the individual lines which carry various signals. Line one transports the digital clock recovery signal, line two carries the digital sync recovery signal, line three sends the system data, lines four through nine handle the address data packets, and lines 10 through 15 hold teletext packets. The horizontal blanking interval can contain as many as six digital audio channels and one utility data channel.

Fig.8-3. MAC sequentially transmits data, chrominance, and luminance within each individual horizontal scan line.



B-MAC encryption offers high video security through a technique known as line translation scrambling. Each line of video information can be delayed by several microseconds, creating a diamond hatched pattern. The digital encryption standard (DES) "key" to the line delay pattern for any service can be changed at frequent intervals, making a one-time cracking of the code exceedingly difficult. Only those terminals equipped with B-MAC decoders which are addressed via a packet of data contained in the vertical blanking interval can switch on and decrypt the signal.

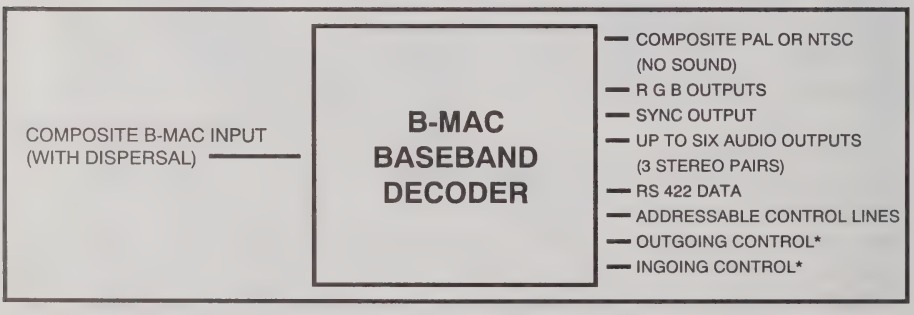


Fig. 8-4. B-MAC baseband decoder interfaces.

CHANNEL A:	Television stereo sound (Right + Left)/2
CHANNEL B:	ABC Radio 2 (monaural)
CHANNEL C:	ABC Radio 3 (monaural)
CHANNEL D:	Television stereo sound (Left)
CHANNEL E:	ABC Radio 4 (Stereo—Right speaker)
CHANNEL F:	ABC Radio 4 (Stereo—Left speaker)
TELETEXT:	ABC TV program guide

Fig.8-5. B-MAC sound channel assignments for Aussat's direct-to-home HACBSS services.

Other Scrambling Systems

In Japan, other unique scrambling systems are in use, including the COATEC and SKYPORT encryption systems. Because these two Japanese descrambling systems are mutually incompatible, Japanese dish owners must use individual descramblers to receive channels using different scrambling methods.

COATEC is used by Japan Satellite Broadcast (BS-3), Japan Sports Channel (JCSat), and Space Shower (JCSat), while SKYPORT is employed by Superbird B's Japan Cable Television (CNN International), Music Television, and Star Channel.

Digital Video Compression

Digital video compression is a new kind of transmission method that can transform a conventional TV signal into a shorthand version that dramatically reduces the amount of frequency bandwidth needed to broadcast the signal. This new technology soon will make it possible for satellite operators to transmit multiple TV signals within the amount of frequency spectrum now used to relay a single standard TV channel.

By using digital video compression, for example, a single satellite transponder can accommodate the simultaneous transmission of up to eight video program services. Digital video compression also uses advanced techniques to produce laser disc quality video and compact disc quality stereo audio.

To receive digitally compressed video signals, you will need to have a special receiver and descrambler or IRD. At the time of writing, no Asian programmers were using compressed video technology. However, satellite companies such as Thailand's Shinawatra intend to use compressed video for their satellite transmissions in the years ahead.

Digital Compression Systems

Several American companies have developed digital video compression systems on behalf of American satellite programmers. Compression Labs of San Jose, California has developed a system which can squeeze as many as eight TV channels onto a single satellite transponder. The Compression Labs system incorporates both compression and encryption components into their customer's IRDs.

DigiCipher is the name of a new video system developed by General Instrument of San Diego, California which combines encryption, compression, and high definition television (HDTV) elements into a single transmission system. Much of the hardware and software development, the compression algorithms, and other elements of GI's DigiCipher system are part of an HDTV system that General Instrument has proposed as a new standard for TV broadcasting in the United States.

Industry experts agree that digital video compression for cable, satellite, and terrestrial TV is coming. In the satellite communications field alone, the use of low-cost digital compression could lead to a dramatic decline in transponder costs, reduce the number of satellites needed by international communications concerns, and cause a major expansion in the number of satellite TV program services—many of them narrowcast offerings that will serve the unique needs of particular segments within the worldwide TV viewing audience.

Digital video compression offers a tremendous opportunity for both satellite operators and satellite-delivered program services to dramatically expand the number of channels available to home satellite TV viewers. This technology will inevitably lead to major advancements in the field of home entertainment.

High Definition Television (HDTV)

HDTV—the first major advance in television picture technology since color was introduced 37 years ago—is to traditional television what the compact disc is to the long-playing album. The new system will transmit TV images in a frame containing more than 1,000 display lines—or more than twice the number of lines used in conventional TV screens. The additional lines produce finer-grained pictures, having a sharpness comparable to that of 35 mm film. Both the color and brightness of HDTV are far superior to anything TV can now deliver. HDTV also features a wider aspect ratio of 16 to 9 as opposed to the 4 to 3 aspect ratio of today's TV sets. As a result, the screen can be viewed from a wider angle without losing the picture's impact. The screen's presence is also less noticeable, and the images appear to have

HDTV features a cinematic 16:9 aspect ratio, more than 1050 lines of resolution, and digital compact-disc-quality stereo sound.

NTSC offers a conventional aspect ratio of 4:3, 525 lines of picture resultion, and analog FM sound.

Fig. 8-6. HDTV versus a conventional NTSC video image. (Courtesy Zenith.)

depth. Finally, high definition delivers superb stereo sound, which no existing stereo TV can match, by using the same digital technique that gives today's compact disc players their excellent dynamic range.

HDTV In Japan

Japan's NHK broadcasting company initiated the first HDTV broadcast via satellite way back in 1978. These primordial HDTV broadcasts required satellite capacity roughly equivalent to three Asiasat transponders just to broadcast one TV signal. By the early 1980s, however, NHK had developed *MUSE*, a more spectrum-efficient HDTV system that can compress the video information so that a single satellite transponder can carry the signal. In 1984, NHK recorded and broadcast the Summer Olympic Games in a high definition format.

In November of 1991, NHK began using one of the Japanese DBS satellites to transmit up to eight hours a day of HDTV programming. HDTV sets are being sold in Tokyo and elsewhere in Japan at prices starting at about US$ 9,000. This price should come down dramatically as broadcasters in other parts of the world adopt HDTV systems and their audiences begin to purchase HDTV sets in large quantities.

Chapter 9
Satellite Audio Services

The improvements in signal quality achieved by today's communications satellites are not restricted to video alone. Many home satellite TV enthusiasts are now enjoying brilliant satellite TV on large screens while surrounded by stereo sound. When listening in stereo, you become engulfed in the scene; one of the fans at mid-field, in the front row seat of a music concert, on the street, in the jungle, or anywhere a movie may take you.

Many of the scrambled services take advantage of the superior audio transmission quality achieved by B-MAC and other scrambling systems. Using a form of digital pulse-code-modulation that is similar to that employed by compact disc players, the B-MAC encryption system can deliver unparalleled audio performance directly to your home entertainment system. No special tuning is required by the operator.

Many unscrambled services also are transmitted in one of three analog stereo formats. Moreover, there are dozens of audio-only services which you can also receive with your dish. These auxiliary services are carried piggyback by many of the video transponders. These stereo and monaural audio services use different frequency side channels called "subcarriers". Several

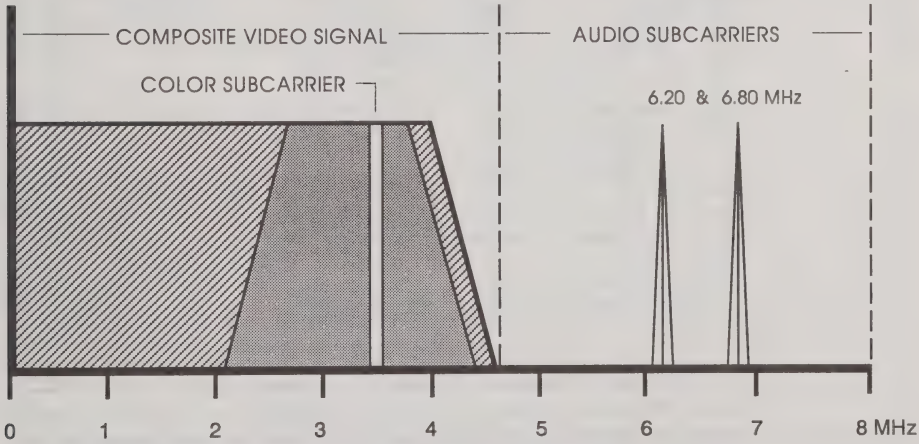


Fig.9-1. The NTSC baseband satellite signal contains both video and audio information.

subcarriers can be included in the "baseband" satellite signal along with the brightness and color information. Their presence does not interfere with the video signal. To receive an auxiliary subcarrier service, you must adjust the receiver's audio subcarrier control to the correct frequency (or frequencies for some stereo transmissions) used by the desired audio service.

Two separate subcarriers often are used to carry the left and right channels offered by those services which broadcast in stereo. This audio format is known as "discrete" stereo. To receive discrete stereo transmissions, the operator must adjust the receiver's left and right audio subcarrier controls to the correct frequencies. While a few of these discrete stereo services are carried in a wideband format, most are narrow band and will require a narrowband audio filter setting on your receiver or IRD for clearest reception.

Asiasat's STAR TV services use a particular form of discrete stereo known as the *Panda Sound System.* Be sure your receiver has been set to receive the discrete Panda stereo subcarrier pairs if you intend to receive STAR TV services in stereo.

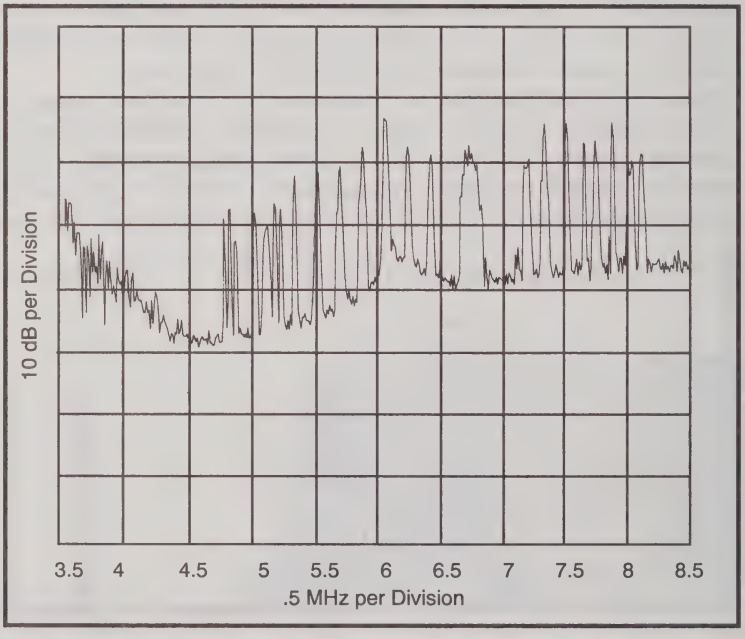


Fig.9-2. The audio subcarrier portion of the baseband video signal can accommodate more than a dozen auxiliary audio subcarriers in addition to the main audio subcarrier at 6.8 MHz which carries the sound portion of the TV program.

Prime Sports	5.58 MHz	English PANDA I stereo (left)
	5.76 MHz	English PANDA I stereo (right)
	5.94 MHz	Mandarin PANDA 1 monaural
	6.20 MHz	ENGLISH wideband monaural†
MTVAsia:	5.58 MHz	English PANDA I stereo (left)
	5.76 MHz	English PANDA I stereo (right)
	6.20 MHz	English wideband monaural †
BBC Asia:	5.58 MHz	English PANDA I stereo (left)
	5.76 MHz	English PANDA I stereo (right)
	5.94 MHz	Mandarin PANDA I monaural
	6.20 MHz	English wideband monaural†
Chinese Channel	5.58 MHz	Mandarin PANDA I stereo (left)
	5.76 MHz	Mandarin PANDA I stereo (right)
	6.20 MHz	Mandarin wideband monaural †
STAR Plus	5.58 MHz	English PANDA I stereo (left)
	5.76 MHz	English PANDA I stereo (right)
	6.20 MHz	English wideband monaural †

†At a future date, these wideband monaural subcarrier will be discontinued and all audio programming will be provided on Wegener PANDA I subcarriers.

Fig. 9-3. STAR TV Audio Subcarrier Plan (ASIASAT-1, Northern Beam)

Prime Sports	6.30 MHz	English PANDA I stereo (left)
	6.48 MHz	English PANDA I stereo (right)
	6.80 MHz	English wideband monaural †
	7.20 MHz	Mandarin PANDA I monaural
MTVAsia:	6.30 MHz	English PANDA I stereo (left)
	6.48 MHz	English PANDA I stereo (right)
	6.80 MHz	English wideband monaural †
BBC Asia:	6.30 MHz	English PANDA I stereo (left)
	6.48 MHz	English PANDA I stereo (right)
	6.80 MHz	English wideband monaural †
	7.20 MHz	Mandarin PANDA I monaural
Chinese Channel	6.30 MHz	Mandarin PANDA I stereo (left)
	6.48 MHz	Mandarin PANDA I stereo (right)
	6.80 MHz	Mandarin wideband monaural †
STAR Plus	6.30 MHz	English PANDA I stereo (left)
	6.48 MHz	English PANDA I stereo (right)
	6.80 MHz	English wideband monaural †

† At a future date, this wideband monaural subcarrier will be discontinued and all audio programming will be provided on Wegener PANDA 1 subcarriers.

Fig. 9-4. STAR TV Audio Subcarrier Plan (ASIASAT-1, Southern Beam)

Fig.9-5. Asiasat auxiliary audio subcarrier services.

Tr.#	Beam	Audio subcarrier service	Frequeny	Mode
4H [7]	NB	BBC World Service Radio (1)	5.94 MHz	PANDA I Mono
6H [11]	NB	BBC World Service Radio (3)	5.94 MHz	PANDA I Mono
7H [13]	NB	BBC World Service Radio (2)	5.94 MHz	PANDA I Mono
9H [17]	NB	Chinese Provincial Radio	7.5 MHz	Monaural
5V [10]	SB	BBC World Service Radio (1)	7.20 MHz	PANDA I Mono
7V [14]	SB	BBC World Service Radio (3)	7.20 MHz	PANDA I Mono
8V [16]	SB	BBC World Service Radio (2)	7.20 MHz	PANDA I Mono

(1) English-language service
(2) Burmese, Bengali, Hindi, Urdu, Pashto, Arabic, Turkish, Mandarin, Indonesian, Vietnamese, Thai, Tamil, Russian, and English
(3) Mandarin, Cantonese, Burmese, Persian, Vietnamese, Urdu, Pashto, & English

Auxiliary audio services are offered to home dish owners. Hotels and cable operators may use auxiliary audio programming either as a separate service for their customers, or as background audio for videotext channels. Radio networks from China and the BBC World Service are available from various Asiasat transponders.

Scanning For SCPC

Unlike conventional audio subcarriers, which can be tuned in by anyone with a satellite TV receiver, there are special radio channels which use an alternate transmission format called SCPC (for Single Channel Per Carrier) that only can be picked up by satellite dishes equipped with special auxiliary receivers.

What Is SCPC?

SCPC is an audio transmission system that commonly is used to transmit a variety of audio program services via satellite. Selected transponders on Palapa and Aussat satellites use SCPC to relay audio programming around the clock. The Palapa B2P satellite uses SCPC to transmit the audio portion of the TV broadcasts for Bangkok TV Channels 5 and 7. Without an SCPC receiver, you will be unable to receive the sound portion of these TV channels. (Unlike audio subcarrier services, which can be received by any satellite TV receiver, Single Channel Per Carrier (SCPC) services only can be received by special SCPC accessories that tap into the 950 to 1450 MHz signal output of the satellite system's LNB.)

SCPC also is used to relay as many as four audio feeds from Radio Thailand to more than forty affiliate radio stations throughout the country. Australia's government-owned ABC radio network and the privately-owned MacQuarie

radio network use Aussat satellite transponders to offer a wide selection of audio programming including news and sports broadcasts, talk radio, and a wide spectrum of music formats. What's more, there are bound to be other SCPC services available on Asian satellites that we have yet to hear about!

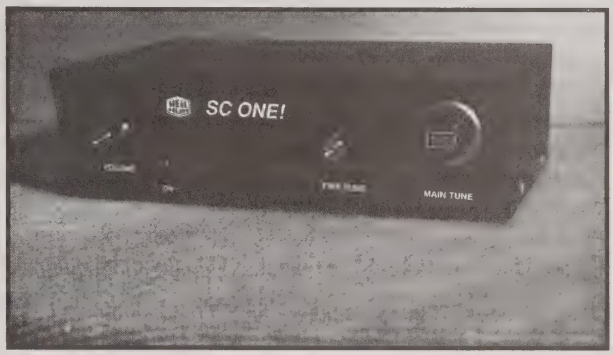


Fig.9-6. The Heil SCPC-1. (Courtesy Heil Communications.)

SCPC radio feeds should be of particular interest to avid sports fans who wish to gain access to virtually any major collegiate or professional sports event. Moreover, dish owners in rural communities can stay abreast of the latest developments.

SCPC Receivers

The Heil SC-1 is the first dedicated SCPC tuner designed especially for the home satellite dish owner. This SCPC tuner has a tuning knob with a three-digit readout that gives you a relative indication of just where your favorite SCPC services are located. Following an initial exploration of the SCPC audio spectrum, the listener should write down the relative three-digit number corresponding to certain favorite channels so that they can be found at any time in the future.

Another way to gain access to SCPC signals is to equip your satellite system with a special type of FM communications receiver called a scanner. Hundreds of thousands of radio enthusiasts around the world already use scanners to receive a wide spectrum of local radio signals, including the radio transmissions of the police, fire brigades, emergency medical services, busi-

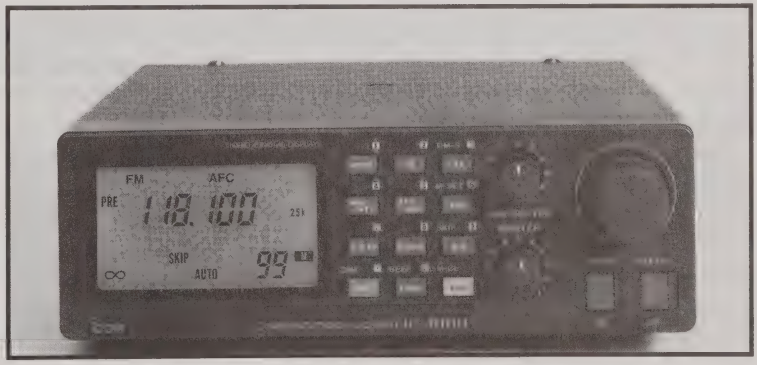


Fig.9-7. Icom IC-R100 scanner. (Courtesy Icom America.)

ness-band communications services, marine radiotelephone calls, mobile radiotelephone conversations, and the broadcasts of the National Weather Service. Scanners also receive VHF aircraft signals, five amateur radio bands, local portable telephone channels, and the audio broadcasts of local TV and FM radio stations.

The Icom IC-R100 scanner provides continuous tuning coverage of a frequency spectrum ranging from less than 1 MHz to more than 1800 MHz—more than enough agility to tune in all the SCPC signals contained in the 950 to 1450 MHz intermediate frequency range provided by your satellite system. The IC-R100 also features a sophisticated scanning system that can provide instant access to all available SCPC frequencies. By depressing the auto-M switch, the IC-R100 automatically memorizes the first 121 active SCPC frequencies encountered while the unit is operating in the scan mode. These active channels then can be recalled at any time by rotating the unit's memory channel selector knob. Other handy features include a front panel direct frequency readout that will help you to dial right in on SCPC services listed in publications such as the *World Satellite Transponder Loading Report.*

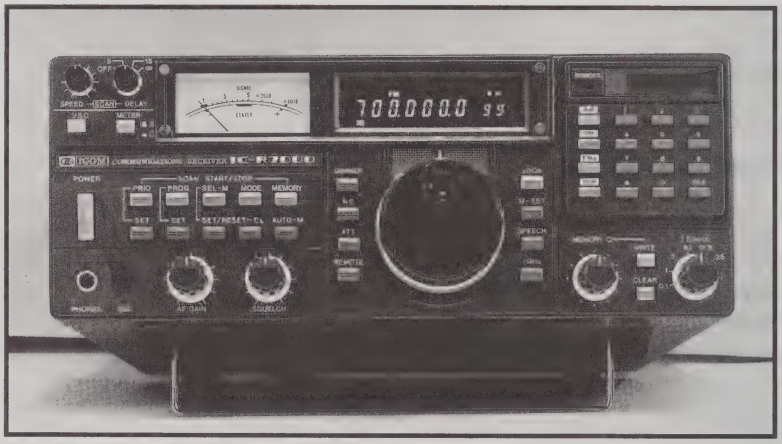
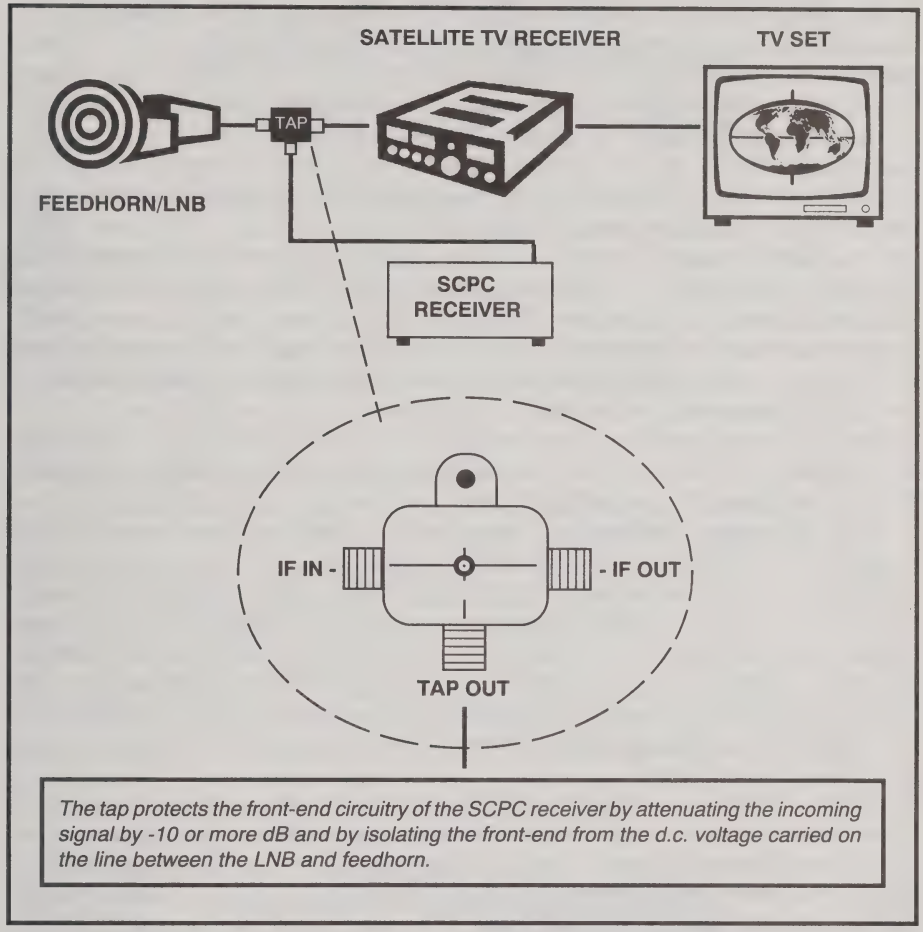


Fig.9-8. Icom IC-R7000 scanner. (Courtesy Icom America.)

There is one important limitation, however, concerning the use of radio communications scanners such as the Icom IC-R100 or the higher-priced Icom IC-R7000 for receiving SCPC transmissions. SCPC audio signals use a variety of bandwidths to transmit through the satellite. The Icom scanners offer wide and narrow-band FM filters that can be used to improve your reception of the vast majority of SCPC services; however, additional filtering is required in order to obtain optimum reception of every SCPC service now available via satellite.

Fig.9-9. Connecting an SCPC receiver to a satellite TV receiving system.



For the price conscious electronics experimenter, Scan Sat Electronics Corporation (12129 Trout Farm Road, Sultan, Washington USA 98294) has developed an SCPC receiver kit which you can build yourself. The company also offers a completely assembled version of their product.

Connecting An SCPC Receiver To Your Satellite TV System

The auxiliary SCPC receiver is connected to the output of the LNB by means of an isolated three-way "tap". The tap should be connected in-line between

the LNB and the satellite TV receiver. A "thru connection" supplied by two of the tap's three "F" connectors acts as a two-way valve, passing a d.c. voltage from the satellite TV receiver to the LNB and feeding the 950 to 1450 MHz intermediate frequency (IF) output signal from the LNB to the satellite TV receiver or IRD. The third F connector on the tap delivers the IF signal to the antenna input of the scanner by means of a short coaxial jumper cable. Supplying -10 to -20 dB of attenuation, the isolated output on the tap reduces the signal level and blocks unwanted d.c. voltages from damaging the scanner's sensitive antenna input circuitry.

Once the SCPC receiver has been connected to the satellite TV system, you can start tuning into the available programming. Move the dish to Palapa B2P, transponder 9 or Aussat A3, transponder 13 and use your satellite TV receiver's remote control to select a transponder that has the same polarity as the transponder that you will be scanning. Now you are ready to calibrate your SCPC receiver's readout.

When tuning in to some of the available SCPC channels, all you may hear is a quieting of the background noise. This indicates the presence of a carrier that is temporarily unmodulated, but which may burst into a frenzy of activity at certain designated times, such as when a news network is scheduled to feed a report to its affiliate stations.

Most of the block downconverters used today for satellite TV reception do not maintain a very stable frequency over time. The dielectric resonant oscillators (DRO) commonly used in most LNBs are susceptible to "drifting"–frequency variations caused by changes in outside temperature over the course of any 24 hour period. To minimize the amount of frequency drift, the LNB should be wrapped in insulation. This will help to stabilize the unit's operating temperature.

An alternative method of obtaining stability is to use a separate C-band low noise amplifier (LNA) and a downconverter that has been specially manufactured for stable operations. Tampa Microwave Lab, Inc. (8742 North Mobley Road, Odessa, Florida USA 33556) manufactures a C-band SCPC downconverter that uses an internally-heated crystal oscillator as a phase-locking reference to provide the ultimate in frequency stability.

Readers in Australia and Southeast Asia should keep in mind that with the launch of Palapa B4 and Aussat B1 in 1992, SCPC services now carried by Palapa B2P and Aussat A3 may move to different transponders on the newer satellites. If a move occurs, you will need to more your dish over to the new satellite and tune through all the available frequencies for both polarization formats in order to find out the new transponder assignments for the SCPC services.

Chapter 10
Satellite TV Distribution in the Home or Condo

A home satellite TV system can be expanded to include satellite reception on all the TVs in your home, and possibly in your neighbor's house or apartment as well. You may want news or sports while the kids want their MTV. You also may live in a trailer court or condominium where, due to space limitations, sharing a satellite receiving system is a practical solution. This chapter presents the various options available for distributing satellite signals around your home and takes a brief look at commercial distribution systems for multiple residences.

Hooking Up Several TVs at Home

Most homes have several TVs on which satellite programming could be viewed. The simplest and most inexpensive way to accomplish this is to distribute the signal from your satellite receiver to the other TVs; then they can view whatever transponder is selected on the receiver. This can be accomplished through the addition of a signal splitter.

Splitters come in different configurations: two-way, three-way, four-way, etc. A coaxial jumper—a short length of RG-59 cable—connects the RF output of the receiver to the input port of the splitter. One output port of the splitter supplies the signal to the first TV; the other port or ports can feed the signal into the bedroom or other secondary locations. Extra splitters can be added anywhere down the line for additional TVs.

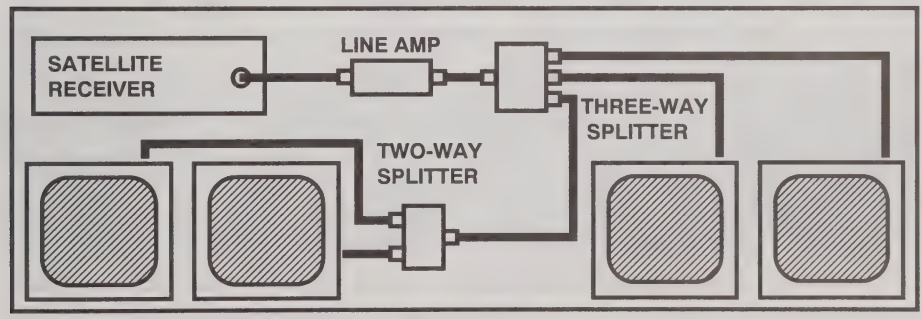


Fig.10-1. In house multiple television wiring diagram.

Whenever the TV signal is split and connected to several TV sets, it's strength will be considerably reduced. Although your receiver should be capable of running several TVs, larger systems with long runs of cable may require additional amplification to maintain a minimum signal level throughout the system. Inexpensive line amplifiers can be added to boost the signal if some TVs exhibit a noisy picture.

Homes with more than one TV often have one master off-air antenna that is connected to all the TV sets. The cable from the antenna usually is divided in the attic to run to all the different TV sets in the home. A device called a "combiner" can be inserted into this cable prior to the signal splitter which feeds the various TVs. A length of coaxial cable connects the VHF or UHF channel output from the satellite receiver's RF modulator to the combiner. From here the satellite signal is distributed—along with the available off-air channels—to all the TVs in the system. What has been selected on the satellite receiver can now be watched by tuning to the TV channel corresponding to the output of your receiver's RF modulator on any TV in the home.

An alternative method is to use a low power UHF TV transmitter to send TV programming from the living room to the bedroom without having to drill holes and string wires. The signals can pass through some walls and floors up to a distance of about 200 feet. This device is connected to the video and audio outputs of the satellite receiver and placed on top of the TV set or in some other high unobstructed location.

Some models transmit UHF frequencies which can be received by the UHF tuner on your TV set. Others use a special remote TV receiver which connects to the antenna input of any TV set. This remote receiver can pick up the special frequencies which have been set aside expressly for home video applications. Additional receivers can be ordered so that multiple TV sets throughout the home can simultaneously receive any program.

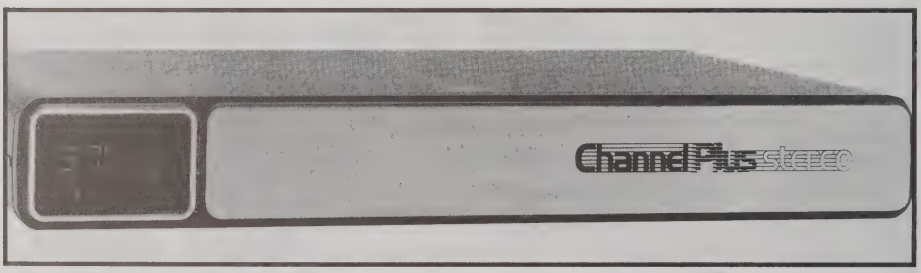


Fig. 10-2. The Channel Plus A3V can be used for distribution on UHF via cable. This device converts video and audio signals from a VCR, satellite receiver, and one other source to unused UHF channels.

Your next door neighbors also could purchase one or more of these special receivers and they too could watch what you are watching. Many people would find such an arrangement too limiting. Reaching agreement about what to view may be all but impossible in your own home, without letting your neighbor have a say as well. Therefore, you might want to consider other systems which can provide independent access to different satellite TV channels.

Multiple Receiver Systems

The next level of independence requires two or more receivers, each choosing among the available satellite TV channels of one polarization. To accomplish this, the signal coming from the LNB must be divided, so that each receiver can operate independently of the others.

With a block downconversion system, each satellite receiver can independently choose from among available channels of the same polarization format. This set-up is perfect for dedicated reception of Asiasat's STAR TV services, since all five TV channels for your region are carried on a single polarization.

Reception of all available TV services on Palapa B2P, however, would require simultaneous reception of both polarization formats. Otherwise, if you change the polarization of the LNB, you change the channels available on all receivers in the system. To receive both polarizations at once, it will be necessary to install a dual polarization feedhorn and two LNBs. With a dual polarization system, each receiver can be independently tuned to any of the available channels carried aboard Palapa B2P or any other available satellite.

One coaxial cable from each LNB is required. Depending on the specifications of the system, other accessories—including V/H polarization switches, line amplifiers, and power blocks—may be needed. A polarization switching voltage supplied by each receiver determines which of the two LNB output signals is to be routed by the V/H switch to the input of its associated receiver.

Some satellite receivers have built-in Vertical and Horizontal switches with separate input connections for each LNB. However, if you are adding a Ku-band LNB to the dual LNB C-band system, an external H/V switch will be required. Whenever the IRD is used for dual band reception, the H/V switch becomes a C/Ku-band switch.

Mini-Cable Systems

While all the systems we have discussed so far would be more or less

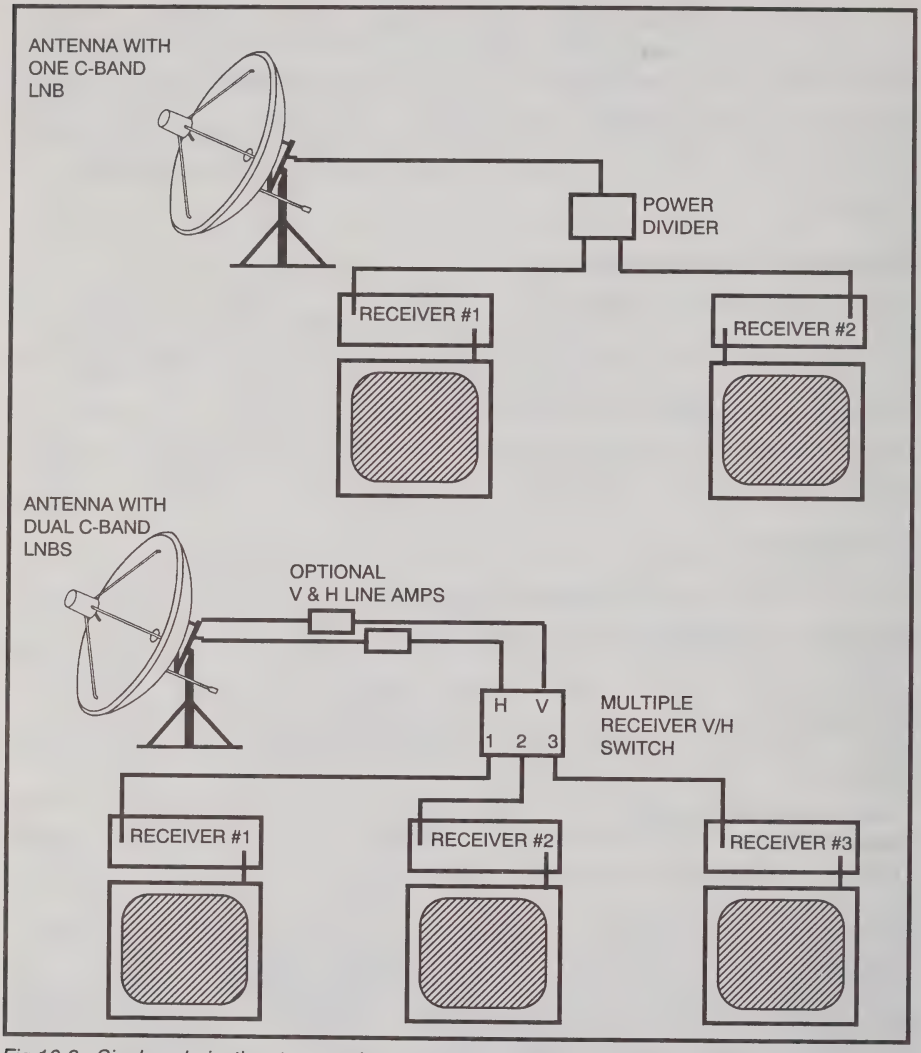


Fig.10-3. Single polarization, two receiver and dual polarization, multiple receiver block systems.

adequate for serving the needs of a few residences or even a small apartment building, cost-effective coverage of larger multiple dwellings requires the construction of a mini-cable system. In apartment buildings, condominiums, trailer parks, and public buildings such as hotels, motels, and health

care facilities, mini-cable systems can be very practical. Often these systems are installed by the owners or managers as a commercial venture. Tenant co-operatives and neighborhood associations also may become involved in the installation of these systems.

Called SMATV (for satellite master antenna), mini-cable systems select a few services off the satellites, change them to regular TV channels, and send them down a cable to the individual residences. A separate satellite receiver is tuned to each service selected. The video and audio from each receiver is connected to an external RF modulator. The output of the RF modulator corresponds to an unused or open channel in the SMATV system. Some manufacturers provide commercial rack mounted receivers and modulators expressly for this purpose.

The local off-air and satellite modulator channels are combined and sent down the cable to each individual residence in the system. All signal levels are balanced to prevent the stronger ones from causing interference to the weaker ones.

When a strong local TV station is directly received off the air as well as through the SMATV system, a "ghosting" condition may result. To prevent this, local channels can be converted to a different channel on the cable, i.e., local channel 2 becomes cable channel 5.

Sometimes a mini-cable system might use the VHF frequencies which lie between TV channels 6 and 7 to carry additional satellite services. Cable ready TVs can be used to

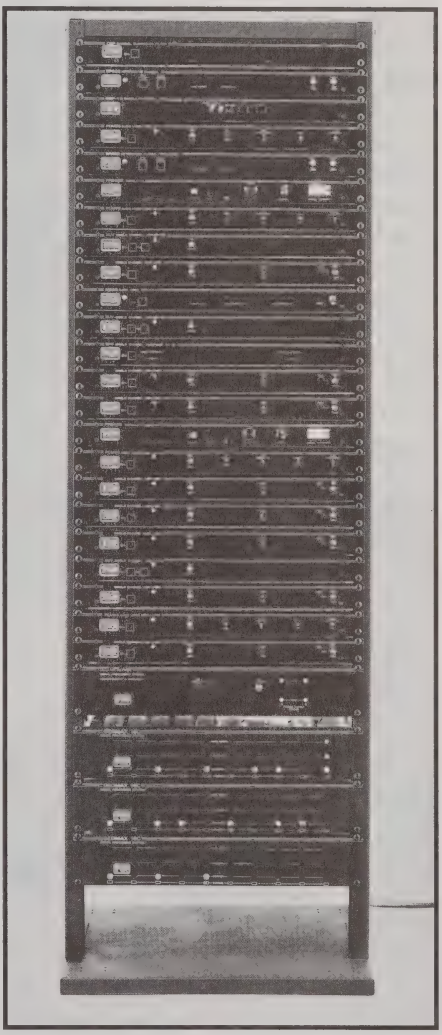


Fig.10-4. Pico Macom Rack Mount. (Courtesy Pico Macom.)

display these channels. Non-cable ready TVs require a special cable box to convert these "mid-band" channels back to ones which can be picked up by a regular TV set.

A videocassette or laser disc player can be added to a mini-cable system for the showing of in-house tapes. A TV camera on the front door or playground also can provide a video signal that could be distributed throughout the complex.

Fig.10-5. Channel Plus solid state video camera. (Courtesy Multiplex Technology, Inc.)

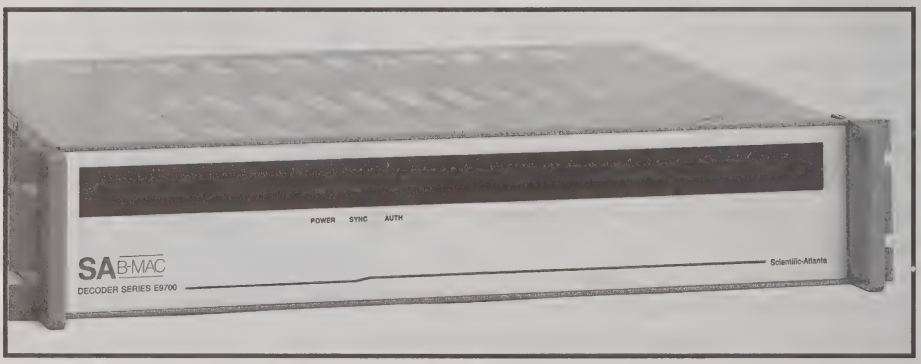


Fig.10-6. Rack-mounted B-MAC descramblers are used in some hotel installations to receive CNN International. (Courtesy Scientific-Atlanta.)

There are many technical considerations involved in the installation of an SMATV system. For example, to receive encrypted services, commercial rack-mounted descramblers or IRDs must be used at the headend. Most equipment manufacturers and distributors have service departments which will help you design the appropriate system and place the correct order for parts.

SMATV operators may find that a spherical antenna, which can view several satellites at once, is a good investment. You can mount a number of feedhorn/LNB assemblies in front of the spherical antenna, thereby giving it the flexibility to simulataneously receive multiple satellites. When a new satellite goes up, you can simply add a new feedhorn/LNB assembly for that bird. Likewise, if you wish to view a special program on a satellite you usually don't watch, you can just add another feedhorn/LNB assembly; since you do not have to readjust the antenna's alignment, the additional programming will be available without sacrificing reception of the satellites you normally view. Moreover, if a program originator changes satellites you too can make the change easily.

Fig.10-7. Spherical antenna. (Courtesy ATC Corporation.)

Multi-beam parabolic antennas also are available. A shallow dish provides a wide look at the Clarke Orbit. Multiple feedhorn/LNB assemblies called "cross-eyed feeds" can be mounted above the dish to allow simultaneous reception of multiple satellites. Keep in mind, however, that multiple-feed parabolic antennas will need to be larger than a dish equipped with a single feed.

Chapter 11
Troubleshooting

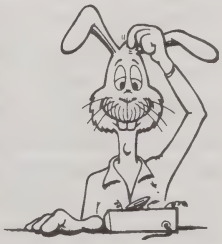
If your system goes on the blink, there are a few things you can check, perhaps even fix it yourself. Many dish owners who live in rural areas can't just call down the block for help; so it's good to know some basic troubleshooting techniques.

When working on any kind of electrical equipment, you must remember, Safety First! Almost all satellite TV receivers and IRDs run on 110 or 220 volts a.c., enough to kill a person. The lower d.c. voltages that run on the cable that connects your receiver to the LNB and actuator, while not enough to do any bodily harm, can cause irreversible damage to expensive electronic circuitry if improperly wired.

There are certain safety precautions that should be taken before removing the cover off a satellite receiver or IRD.

- » Never take the cover off with the power cord plugged in.
- » Move any metal objects or wires well away from the receiver when testing or working on it; this helps prevent an accidental short circuit.
- » Never turn on a receiver or IRD unless a fuse of the correct amperage is in the fuse holder.
- » Do not touch any components inside the unit while the power is connected.
- » Water is a good conductor of electricity; do not work on a receiver or antenna actuator if you are wet or if you are standing in a puddle.
- » Do not work on your set while there is a lightning storm in progress.

If you are going to get inside the satellite receiver, be sure you know the proper procedure. Aimlessly twiddling the various tuning pots and capacitors in your receiver might look inviting, but without proper test equipment self inspection of the satellite receiver could turn your entertainment center into an expensive junk sculpture. You also may void the warranty.



Now, having given you a proper warning, it is only fair to point out that many times the problems which occur are quite simple and can be taken care of easily. Although some systems offer slightly different features they are all comprised of similar basic components. It therefore stands to reason that you would follow the same troubleshooting procedures for any home satellite TV system. This guide to troubleshooting will provide you with an overview of the common problems encountered, how to identify them, and their solutions.

Before getting very far into troubleshooting, you will need to understand how to use a volt ohm meter—a basic electrical tool that can be used to measure voltages and to check for shorted connections or breaks in the wiring. When checking your system, it would also be handy to have access to a spare LNB. You may reach a point where the LNB could become the main suspect.

While all systems work in a similar fashion, there may be idiosyncrasies with your particular model of receiver or antenna positioner. Manufacturers have service departments which will be glad to help you and are most likely to be familiar with the problem you are experiencing.

Installation Tips

Make sure that your TV set has been fine tuned to the channel output of the receiver's RF modulator. Some TV sets may have to be programmed to receive the satellite receiver's RF modulator channel. You would be surprised how often this is overlooked. You can by-pass the receiver's RF modulator by connecting the video and audio outputs through a VCR or directly to a TV monitor. If you receive a picture from the receiver's video output but not from the RF output, the problem could be a bad modulator.

A long length of cable between the receiver and antenna may markedly reduce the signal level to the receiver. In-line amplifiers are available to increase the signal strength. Many satellite receivers have IF gain control adjustments which are turned down at the factory to keep the LNB from overdriving the receiver whenever a short cable run is used. High signal levels will cause noise to appear in the picture. This noise looks just like the sparklies seen while receiving a weak satellite signal. A low signal level also can inhibit any descrambler from decoding a scrambled channel.

The trick is to find the receiver's IF gain control. Sometimes this control is on the back, the bottom, or on the side of the satellite receiver. It may even be located inside the unit. Check your instruction manual. If there is no mention of an IF gain control in the manual, ask the manufacturer if one is provided. The gain control should be adjusted so that the strongest channels almost peak your signal strength indicator.

Problems Associated With the Electronics

If one day your system stops receiving a picture—or only receives a noisy picture with very little signal registering on the meter—either bad weather has shifted the antenna's alignment or some part in the system has failed. Check the antenna to see if the marks you made on the pole and the mount during the installation process are still lined up. If your picture fades in and out on windy days, tighten any loose bolts on the mount and actuator arm to eliminate any sloppiness or "play".

Check the antenna's alignment by having someone push up or down, or left and right, on the rim of the antenna while you look at the meter reading of the satellite receiver. If the meter level goes up when someone pushes on the dish, then the antenna is no longer properly aligned.

Move the antenna until it reaches its highest elevation angle. If you push up on the antenna and the signal level goes up, the antenna's mount should be rotated slightly counterclockwise. If you push down on the antenna and the signal level goes up, the antenna's mount should be rotated slightly clockwise.

Be sure to make your adjustments in tiny increments and recheck the alignment by using the above mentioned procedure once again. If you continue to have an alignment problem refer back to the alignment section of the installation chapter for further assistance.

If there are no problems with the antenna or mount, you can assume that something is wrong with the system electronics. You will need to isolate the problem down to the individual component that is responsible. Start at the receiver and work your way out to the LNB, checking any in-line amplifiers or other components along the way. Temporarily take any splitters or switches out of the system and connect the LNB directly to the receiver. If the system works after this, one of the disconnected components must be bad.

Most receivers deliver 18 volts d.c. up the coax to the LNB—even when the equipment is turned off. This helps prevent moisture from condensing inside the LNB housings and enhances LNB stability by minimizing any temperature variations. Unplug the satellite receiver from its wall receptacle before connecting or disconnecting the IF cable. This will protect the electronics from possible damage in the event that you accidentally short out the connections.

Check to see if there is 18 volts d.c. coming out of the back of the receiver. The LNB can't function without power. There is a fuse or circuit breaker inside the receiver which protects this circuit. A short in the line does not ordinarily blow the receiver's main fuse or circuit breaker.

Unplug the receiver from the wall receptacle, and then locate and replace

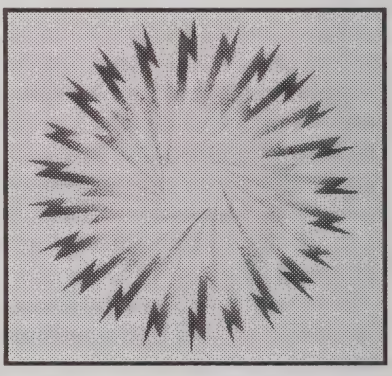
the blown fuse. Before you reconnect the IF cable, turn the receiver back on and see if the fuse blows once again. If it does, there is a problem in the receiver's power supply and the unit will have to be sent back to the manufacturer for repair.

Most of the problems you run into are caused by water intrusion. Check both ends of the cable and any connectors between the LNB to see if any piece of braid is touching the center conductor or if water in the connectors is causing a short. Any moisture here also can make your picture look jumbled, very weak, or even blank. This can be prevented by using a waterproofing compound around the connector or flooding the connector with a dielectric sealant.

When checking cable for continuity, first unplug the satellite receiver, disconnect the cable from the LNB, then reconnect the cable and plug the receiver back in. If the fuse blows, there is a short in the cable. If the new fuse doesn't blow, check to see if you have 18 volts d.c. at the far end of the cable. Lack of voltage indicates a break in the cable, which will have to be replaced. Check it for continuity.

We recommend that you unplug the receiver when making or breaking these connections. If the fuse is blown by accidentally shorting the cable, an accurate test cannot be made and damage to the LNB could occur.

LNBs are very susceptible to water and to lightning damage. A lightning bolt doesn't have to physically hit the dish to wreak havoc on your system. Nearby lightning strikes can generate a transient voltage which can fry the sensitive microwave parts of the unit. A bad amplifier stage in a LNB will be evident if you receive clear pictures on the lower channels but noisy pictures on the high end, or vice versa.



An eight-foot ground rod pounded in next to the dish provides some lightning protection for your system. Copper braid ground straps connect the dish and antenna actuator to the ground rod. Check to be sure that the ground straps are providing your system with a good electrical connection. If any corrosion of these connections is discovered, disconnect the copper ground straps, scrape them clean with a knife, and then reconnect them to the system.

Take the cover off the feedhorn and LNB assembly and check the neoprene gasket that seals the joint between the feedhorn and LNB. The LNB should

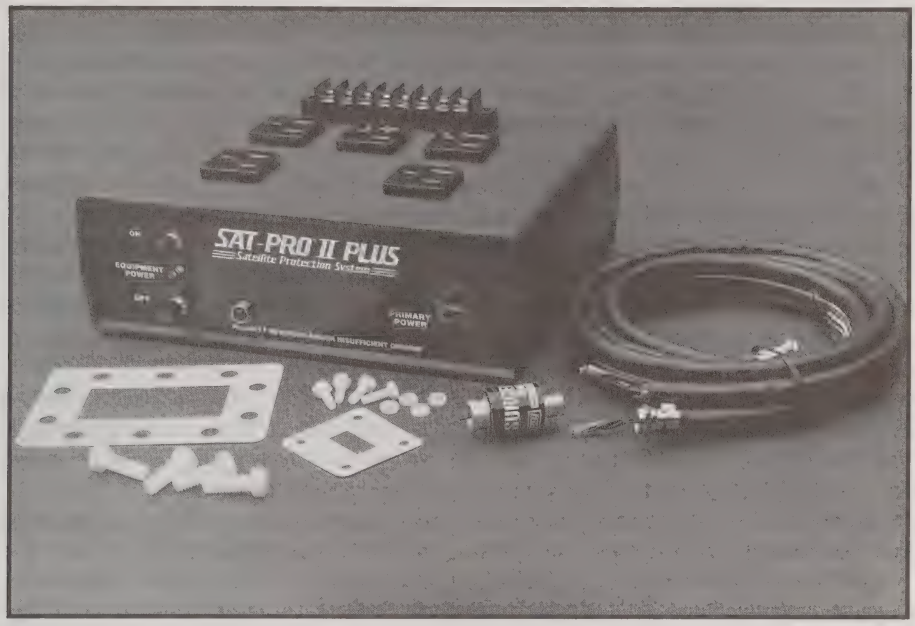


Fig.11-1. The Sat-Pro II Plus will protect your IRD from lightning and other power line voltage spikes and surges before they can cause damage to any part of the satellite entertainment system. All the cables going out to the dish are connected through connectors on the front and back of this unit. (Courtesy Universal Research and Development, Inc.)

be tightly bolted to the feedhorn. If the mounting bolts are loose or if the gasket was improperly seated during installation, moisture will be able to seep around the gasket and enter the feedhorn's waveguide—the metal joint that links the feedhorn to the LNB. If you do discover that moisture has gained entry into the waveguide, use a hair dryer to remove the condensation then carefully reattach the LNB to the feedhorn flange so that the gasket completely seals the joint.

If water has condensed inside your LNB, it is possible to return this component back to life by taking it inside and drying it out. Do not open the LNB as this will void its warranty. These units contain especially sensitive microwave transistors which are beyond the ability of most mortals for home repair.

If the LNB is receiving the proper voltage and there is no evidence of moisture in the connections, check to see if replacing the LNB will correct the problem. If after substitution the system still doesn't function properly, inspect the feedhorn. On rare occasions a feedhorn that won't pass the signal on to the LNB simply needs to be checked to make sure that wasps or other

insects haven't built a new home in the throat of the unit.

If everything checks out and you still don't receive a good picture, try a new receiver or try the receiver on someone else's system. You could have a bad electronic stage inside the receiver.

Problems Associated With Actuators

The major culprit when it comes to problems with actuators is water! No matter what you do, water is going to get into the motor housing. Water accumulation can short out the connections to the actuator and blow the circuit breaker in the positioner or satellite receiver. This can easily be corrected by drying out the inside of the actuator and cleaning the connectors.

It is important to have a way for the water to escape. Make sure to follow the directions during installation which usually place the incoming wires on the top side of the motor and the drain holes on the bottom. If there aren't any drain holes, remove the actuator cover and drill a drain hole in it.

If you don't move your dish frequently from one satellite to another, the arm can corrode and become stuck. The arm should be cleaned and lubricated periodically. Fully retract the antenna's actuator arm, clean it with a solvent, then lubricate the arm with a waterproof "marine grade" grease that can withstand continual exposure to the weather.

If the dish won't move at all, a bad connection to the actuator's motor could be the cause of the problem. After making sure the parental lockout has not been activated, check to see if 36 volts d.c. is present at the back of the satellite receiver whenever the antenna is commanded to move.

Some antenna positioners provide 24 volts d.c. to the actuator motor instead of 36 volts d.c. Providing only 24 volts will not affect the actuator motor. Check the specifications in your owner's manual.

Next, check to see if this voltage is being received at the motor terminals inside the actuator housing. If it is not reaching the motor terminals you may have to replace the actuator cable. If the voltage is present at the motor terminals and the actuator still doesn't engage, there may be an open winding in the motor which will need to be replaced.

All actuators have a circuit that generates pulses and delivers them to the receiver for counting. If the dish momentarily moves and then shuts down, the receiver didn't get a pulse from the actuator's sensor. This symptom is usually accompanied by an "actuator error" readout on the TV screen or on the receiver's front panel display.

Several different kinds of sensors are used in the actuators being manufactured today. Some of these require 5 volts d.c., while others do not.

Although a bad sensor is a common problem, it can easily be replaced. If your actuator is the type that uses a magnetic wheel, make sure that the sensor is close to—but not actually touching—the wheel. These magnets sometimes wear out and may need to be replaced. If you determine that these components are good and the receiver still does not get a count, check the sensor wiring for continuity.

If your particular sensor requires 5 volts, make sure that the current is reaching the motor. If your receiver stops supplying 5 volts to the actuator, it is a good idea to switch to a reed or other type of sensor which doesn't require voltage.

If the dish doesn't precisely locate a specific satellite every time, check the antenna mount for signs of any slop or play. Move the dish up or down by hand to discover which bolts may need to be tightened or what other antenna parts need to be replaced. If you need to realign the programmed locations for all satellites, it may not be necessary to reenter the location for each individual bird. Many satellite receivers provide an automatic antenna realignment feature that can be used after reprogramming the location for a single satellite. Be aware, however, that this will realign your east and west limits as well.

If the satellite receiver loses its memory, the unit's back-up battery may not be supplying power to the memory circuits during power outages. The unit's microprocessor may also be blown. Refer to the owner's manual for further information about repair or replacement.

Problems Associated With Polarizers

If you are receiving only one polarity or are receiving two polarities at once and cannot skew the polarity to make the picture come in, there may be a problem with the servo motor on the feedhorn. The servo motor also can freeze up in winter. Moreover, servo motors wear out and must be replaced.

The best way to check the servo motor is to bring the feed inside and hook it up directly to the back of the receiver. As you change the receiver's polarity or skew settings, the probe in the mouth of the feed should rotate in a clockwise or counter-clockwise direction.

If the probe doesn't move, use a volt ohm meter to determine if the receiver is generating 5 volts d.c. whenever you adjust the polarity. If not, the problem lies in the receiver's internal power supply. A few receivers have an internal fuse which protects this part of the power supply. Consult with the receiver's manufacturer, and if their product doesn't have a separate fuse, be sure to ask for a return authorization number and send the receiver in for repair. If you can't stand the pain of being apart from your receiver, buy an external

polarizer control.

If 5 volts d.c. is present at the feed and the probe still doesn't move, you will need to replace the feed's servo motor. A replacement servo is relatively inexpensive. If the probe does move when hooked directly to the receiver, check the wires going out to the dish for a break or short in the line.

Remember, when installing a feedhorn on the antenna, it must be aligned so that the probe can swing the 90 degrees from horizontal to vertical (or left-hand circular to right-hand circular) polarization without reaching its limit of travel. If you can't skew the probe beyond a good picture on odd and even channels on all satellites, the feed must be physically rotated until it is possible to do so.

Electronic ferrite feeds have no moving parts, so you won't be able to physically observe any movement during operation. Instead, use the volt ohm meter to determine whether or not the feed is receiving 18 volts d.c. You can also check the windings to see if there is continuity across them.

The additional weight of adding a Ku-band LNB to your C-band system may cause the feed to droop off center. Guy wires should be added to button hook feeds to help position them directly over the center of the dish. Once the guy wires are in place, measure from the rim of the dish to the outer ring feedhorn from several locations. The feed is centered if all these measurements are equal.

Fighting Terrestrial Interference

Even if your initial site survey revealed no interference, there is no guarantee that the telephone company will not start transmitting through your area sometime in the future. Microwave interference typically shows up as a problem on a few satellite channels. In some extreme cases, when the source of the terrestrial interference (TI) is strong and nearby, it can wipe out a channel or a whole block of channels on one or more satellites. Some channels may be blacked out or have sparklies that simply won't go away, while other channels will look just great.

A dead giveaway that TI is present is indicated when certain channels appear to be weaker, yet the signal strength meter registers higher than on other channels. You may have to fine tune the video away from the TI carrier frequency to receive the best picture. Try adjusting the video frequency to see if the picture improves even if the signal level goes down. On some receivers you can store the best setting into memory.

You also should suspect microwave interference if sparklies only affect reception of certain satellites and channels; there may be a tower off in that direction. If your receiver does not have a TI filter or this setting does not

seem to do enough to clear up the interference, you can use an external "notch" filter to selectively remove the portions of the receiver's IF bandwidth where TI normally will appear. This will remove the relatively narrow telephone microwave carriers from the affected transponder's 36-MHz bandwidth, while passing the majority of the satellite signal. If the notch filter alone does not fully remove the interference, there also are passband filters that can be used to further adjust the passband of the receiver.

Check the receiver's back panel to determine whether it can accept an "outboard" filter. If the receiver has a short jumper cable linking the input and output ports of its second IF, it can accept a filter.

Some receiver manufacturers also provide modification kits for receivers which didn't originally come with IF loop-through connections. The frequency of the filter you purchase must match the IF loop-through frequency scheme of the receiver (70-, 140-, 510-MHz, etc.). U.S. companies such as Phantom Engineering, ASP, and Microwave Filter Company offer a complete line of filters that can interface with the 2nd IF loop-through frequencies of almost any receiver.

When you encounter very strong TI which wipes out an entire channel or group of channels, filters alone will not eliminate the problem. In this case, the interference must be blocked before it reaches the LNB and receiver. It may be possible to move the dish to another location which is shielded from the TI by your house or another building. You also can build a solid metal fence or screen, positioning it between the microwave source and your antenna. Make sure the fence or screen is well grounded. In extreme cases, there special microwave filters are available which are attached ahead of your LNB.

Problems with Descramblers

If your satellite TV system is equipped with a descrambler, you should be aware that the presence of TI can prevent your unit from locking on to a scrambled channel. The use of a notch filter is the preferred way to handle this situation. Passband filters generally are ineffective for removing TI from scrambled channels because they remove so much of the incoming signal that the descrambler will not lock onto the service.

Many satellite receivers and IRDs come with built-in TI filters which you can program into memory on a channel-by-channel basis. When using a TI filter, be sure to adjust the video fine tune for the affected channel until the best reception is obtained.

If your descrambler will only intermittently lock on to one or more of the scrambled channels, the frequency setting of the receiver may be slightly off

from center frequency. In this case, use the receiver's video fine tune control to adjust the frequency setting so that the unit will lock on to and authorize the scramble service reliably.

If you have been on a long vacation or for some other reason your descrambler loses its authorization, you can tune to any channel to which you subscribe and call the subscription service for an "instant hit". This should bring it right back to life.

If the unit seems to have lost its memory and will not display its ID number, the battery in the descrambler may have worn out. The battery is there to hold the memory intact whenever the power goes out or the unit is unplugged. Designed to last for several years, the batteries eventually wear out and will need to be replaced. The module will have to be sent back to the manufacturer or its authorized service center. The service center will install a new battery and re-insert your authorization keys. Opening the module yourself will void the warranty.

Winterizing Your System

While most of the Asian and Pacific Rim countries are blessed with warm weather the year round, there remain areas where freezing temperatures may occur. If you live in one of these locations, make sure that you take a critical second look at your home satellite TV system each year before cold weather arrives. A few simple preventive maintenance procedures can keep your satellite TV system from going on the blink.

If you live in an extremely cold climate, try wrapping several feet of heat tape around the actuator's motor and gear box and then cover it with foam insulation and a plastic bag to prevent the tape and insulation from getting wet. Once the snow begins to fall, periodically move the antenna to the extreme east or west limits and brush out the snow and ice, or it can accumulate and place a heavier-than-ususal load on the dish's actuator motor as well as weigh down the reflector, distorting its shape.

The antenna's plastic LNB/feedhorn cover provides your system's sensitive microwave components with additional protection from the elements. Take a moment to inspect the cover to ensure that moisture isn't gaining entry through a crack or seam. Also make sure that the feedhorn's plastic cap is tightly in place. This will prevent moisture from blowing into the throat of the feed, where it could freeze and thereby prevent the feedhorn's pick-up probe from freely rotating.

Chapter 12
How to Receive International Satellite Signals

There are numerous INTELSAT and STATSIONAR satellites which can be received from locations throughout Asia and the South Pacific. Reception of these satellite signals often requires specialized equipment and expertise. The following chapter will present you with all the information that you'll need to succeed in receiving the available international TV and radio signals.

INTELSAT V & V-A Satellites

INTELSAT V and V-A satellites carry four types of beam antennas: global, hemispheric, zone and spot. The type of beam can be selected by ground command for maximum versatility.

Global Beams. The global beam pattern covers the largest amount of surface area of the Earth—up to 40 percent. This pattern is used extensively by INTELSAT, particularly when sending television feeds from one hemisphere to the other. These feeds range from short news items of three minutes or less to complete coverage of major sporting or news events.

When a six-watt transponder signal is projected over the global beam area, extremely large dish antennas are necessary to pull in the weak, thinly spread signals. Global coverage signals are still of interest to the experimenter who can get a picture of sorts by using variable bandwidth reception techniques.

Hemispheric Beams. Several countries lease INTELSAT hemispheric beam transponders to provide domestic and international television coverage. By narrowing the satellite's beam pattern, the hemispheric beam covers just 20 percent of the earth's surface. This allows smaller and less expensive receiving antennas to be used down on the ground. Reception of hemispheric beam transmissions is possible by earth station antennas in the four to five meter range, with crystal-clear reception usually requiring a dish at least six meters in diameter.

Zone Beams. The zone beam transmits its signal into an area less than half the size of a hemispheric beam. This doubles the signal intensity, allowing dishes four meters in diameter to perform effectively.

Spot Beams. INTELSAT V satellites carry two steerable Ku-band spot

beams that can be commanded to point at any location north of the Earth's equator that is visible from the satellite's orbital position. In addition to their Ku-band spot beams, the INTELSAT V-A satellites also carry steerable C-band spots. The INTELSAT V-A F13 and F15 satellites have been modified to direct their C-band spot beams over locations south of the Earth's equator, including South America. Both the C- and Ku-band spot beams can deliver domestic television and telecommunications services into small-diameter antennas that are located within their respective coverage areas.

Fig.12-1. INTELSAT V & V-A Satellites (as of April, 1992)

F1 Status: Pacific Ocean contingency spare satellite with domestic and international services.
Location: 177° W [183° E.]

F2 Status: Atlantic Ocean contingency spare.
Location: 21.5° W. [338.5° E.].

F3 Status: Pacific Ocean contingency spare.
Location: 177° E. [183° W.].

F5 Status: Indian Ocean contingency spare with domestic services.
Location: 66° E. [294° W.].

F6 Status: Atlantic Ocean contingency spare.
Location: 50° W. [310° E.].

F7 Status: Indian Ocean contingency spare.
Location: 57° E. [303° W.].

F8 Status: Pacific Ocean spare with domestic services.
Location: 180° E./W.

F10 Status: Pacific Ocean (formerly primary) satellite
Location: 174° E [186° W.].

F11 Status: Atlantic Ocean [formerly primary/major path] with domestic & international services.
Location: 63° E. [297° W.].

F12 Status: Atlantic Ocean spare with domestic & international services.
Location: 1° W. [359° E.].

F13 Status: Atlantic Ocean contingency spare with South American spot beam and International Business Service (IBS) capacity.
Location: 53° West [307° E.].

F15 Status: Atlantic Ocean contingency spare International Business Service (IBS) capacity.
Location: 18° W. [342° E.].

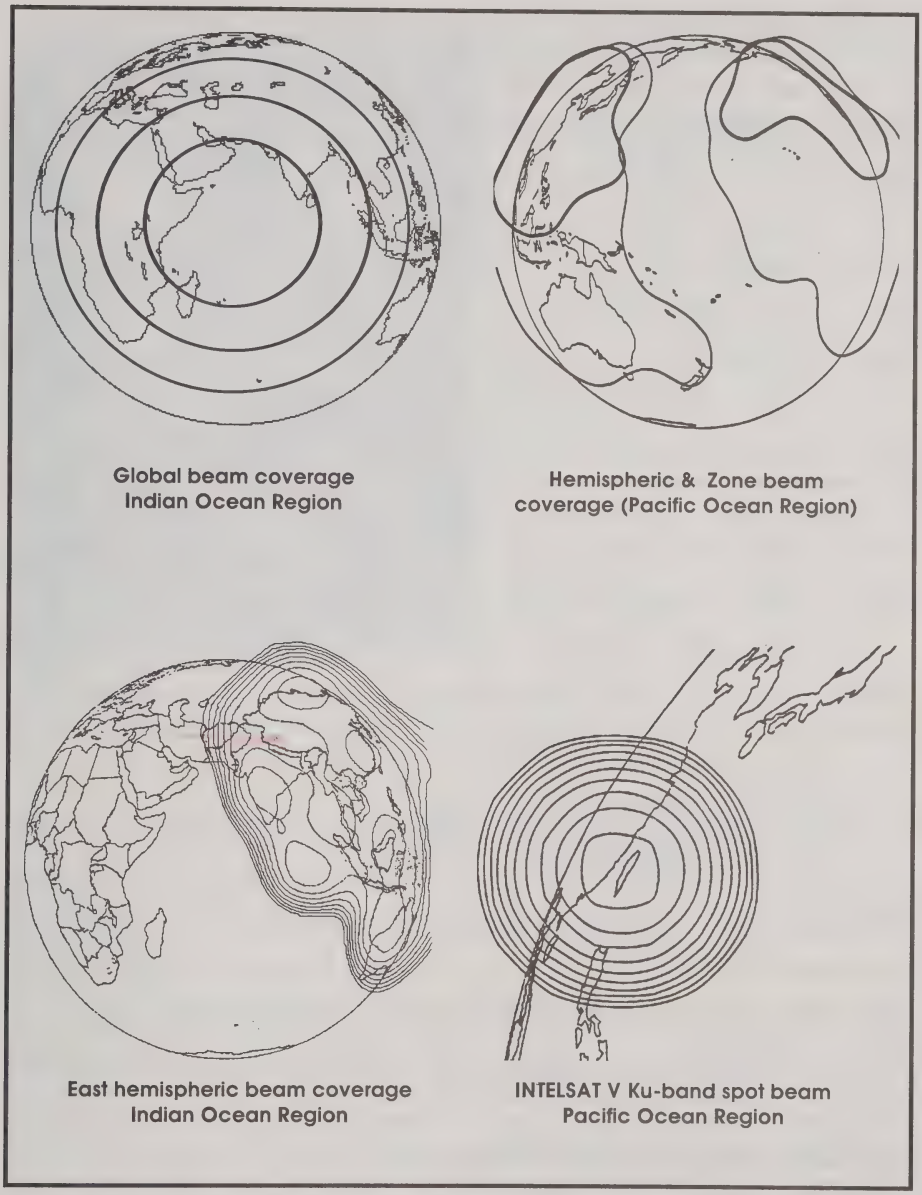


Fig.12-2. INTELSAT Global, hemispheric, zone and spot beam coverage.

The INTELSAT VI Satellites

INTELSAT VI communications satellites are capable of carrying 120,000 telephone circuits as well as three television channels. Each INTELSAT VI carries 38 C-band and 10 Ku-band transponders.

The INTELSAT VI satellites differ from the INTELSAT V and V-A spacecraft in several respects. The coverge of the east and west Ku-band spot beams have been enlarged to cover a greater area of the Earth's surface. Full steerability also has been added so that the Ku-band spot beams can be directed toward locations south or north of the Earth's equator. INTELSAT VI satellites also carry more Ku-band transponders than their predecessors.

On C-band, each INTELSAT VI provides four fully independent C-band zone beams (NE,NW, SE, & SW). Additional C-band hemispheric transponders also have been included. In terms of power, INTELSAT VI offers improvements of +3 dBW or more over its predecessors in every available beam and transponder.

Fig.12-3. INTELSAT VI. (Courtesy INTELSAT.)

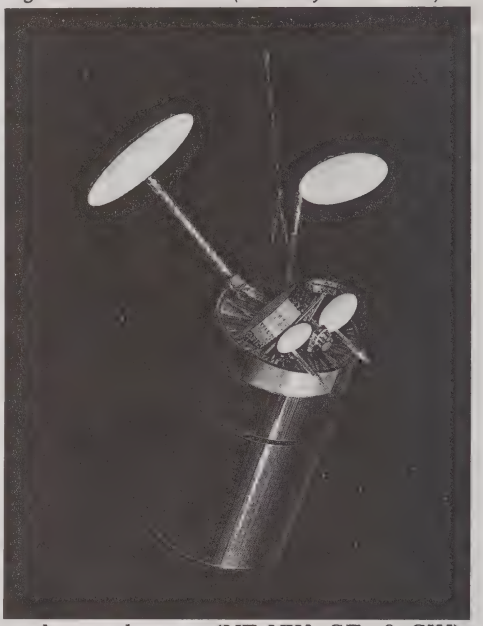


Fig.12-4. INTELSAT VI Satellites (as of April, 1992)

F1 Status:	Atlantic Ocean contingency spare satellite with domestic and international services.
Location:	27.5° W. [332.5° E.].
F2 Status:	Indian Ocean [formerly major path/primary] satellite with domestic services.
Location:	63° E. [297° W.].
F3 Status:	Scheduled for 1992 redepoloyment by NASA space shuttle.
Location:	Assigned to Atlantic Ocean Region at 34.5° W. [325.5 E.].
F4 Status:	Atlantic Ocean contingency spare satellite with domestic and international services.
Location:	60° E. [300° E.].
F5 Status:	Atlantic Ocean [formerly primary path].
Location:	24.5° W. [335.5° E.].

Fig.12-5. INTELSAT satellite coverage comparison chart.

TR No.	Freq. MHz	INT V	INT VA	INT VI
00	3685	——	——	H & Z
01	3725	H & Z	H & Z	H & Z
02	3765	H & Z	H & Z	H & Z
03	3805	H & Z	H & Z	H & Z
04	3845	H & Z	H & Z	H & Z
05	3885	H & Z	H & Z	H & Z
06	3925	H & Z	H & Z	H & Z
07	3975	H & Z	H & Z	H & Z
08	4015	G or H & Z	G or H & Z	G or H & Z
09	4055	H or G	H or S or G	H or G
10	4095	G	S &/or G	G
11	4135	G	S &/or G	G
12	4175	G	S &/or G	G

S = C-band Spot Beam
H = East or West Hemispheric Beam
Z = East or West Zone Beam
G = Global Beam

INTELSAT VII

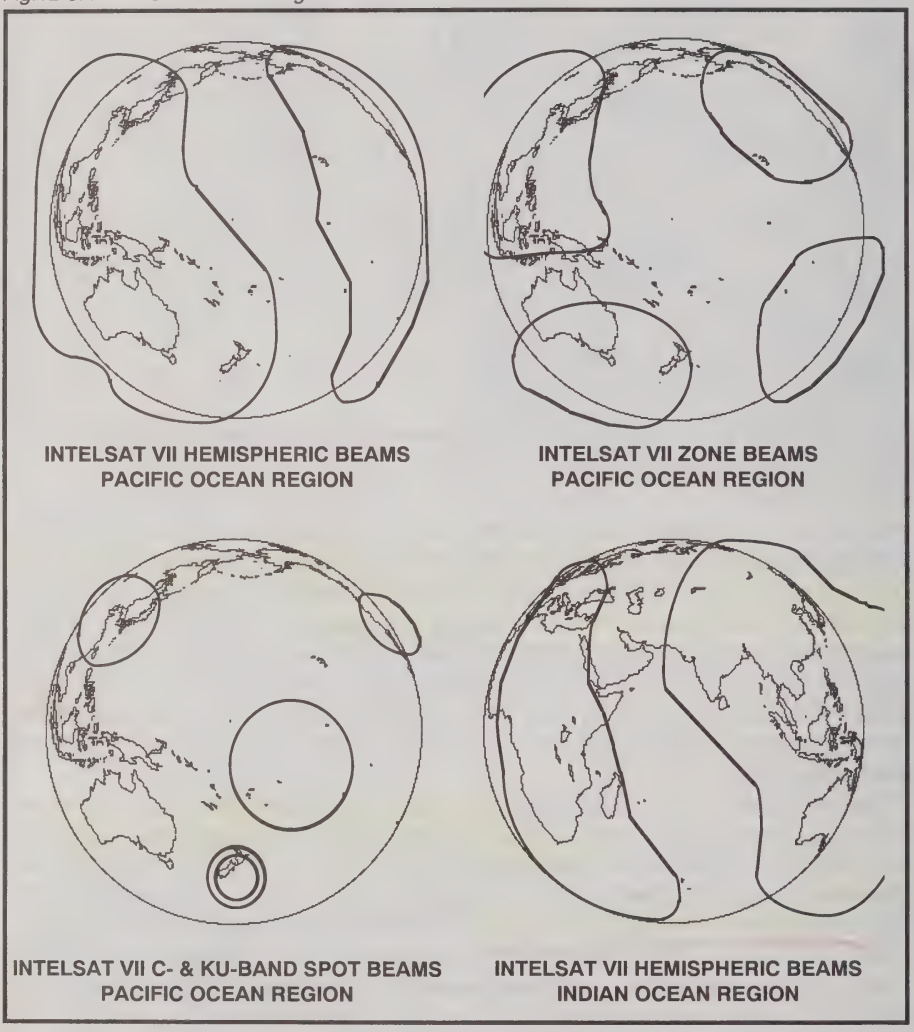
The first in a new series of INTELSAT VII satellites is scheduled to be launched in late 1993. INTELSAT VII satellites will provide follow-on service for the Pacific Ocean Region from 174 and 177 degrees east longitude. The new satellites will replace two INTELSAT V-A satellites that, by 1993, will be nearing the end of their operational lifetimes. Three additional INTELSAT VII and two INTELSAT VII-A satellites will be positioned over the Atlantic and Indian Ocean Regions at orbital locations that do not require high traffic concentrations: 307, 342.5, and 359 degrees east (53, 18, and 1 degrees west) longitude.

The INTELSAT VII satellites will carry a smaller payload than the INTELSAT VI series spacecraft in terms of the number of repeaters and total available bandwidth, and utilize a smaller and simpler C-band Hemi/Zone antenna. However, the satellite will feature a spectacular array of capabilities including substantially higher EIRP levels, as well as the possibility to choose, independently for each transponder, between the 11 GHz and the 12 GHz downlink frequency bands. These capabilities will give INTELSAT greater flexibility when serving its customers around the world.

The higher power generated by the INTELSAT VII satellites will allow

INTELSAT customers to use smaller, less-expensive earth stations. INTELSAT VII's three independently-steerable Ku-band spot beams and single, steerable C-band spot beam also will allow INTELSAT to offer a multitude of cost-effective domestic communications services to any country on Earth.

Fig.12-6. INTELSAT VII Coverage Beams.



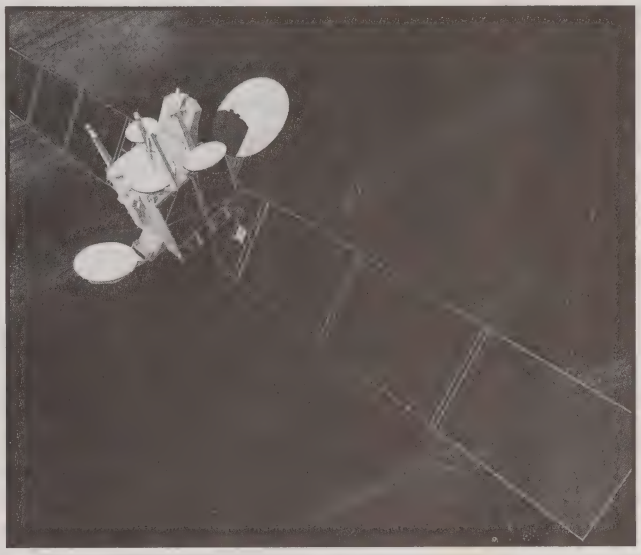


Fig.12-7. INTELSAT VII (Courtesy INTELSAT.)

INTELSAT Polarization Standards

All INTELSAT C-band satellite transmissions use circular polarization. Instead of positioning the microwave energy in a vertical or horizontal plane, circular polarization is transmitted in a helical pattern, with the wave front rotating either to the right or to the left. All INTELSAT V global beam signals use right-hand circular polarization (RHCP), while INTELSAT V-A and VI satellites carry both right-hand and left-hand circularly polarized global beams.

To allow a four-fold increase in frequency use over preceding satellite designs, the INTELSAT V, V-A, and VI series satellites use right-hand circular polarization for their hemispheric beams and left-hand circular polarization for their zone beams. This is referred to as cross-polarization and allows simultaneous use of hemispheric and zone beams in both the westerly and easterly directions. The INTELSAT V-A C-band spot beams for South America also use both polarization formats, allowing frequency reuse within this restricted area of the globe.

Instead of circular polarization, the INTELSAT steerable Ku-band spot beams use linear polarization. The west spot beam is horizontally polarized on the downlink side while the east spot beam is vertically polarized.

INTERSPUTNIK and the STATSIONAR Satellite System

Like INTELSAT satellites, the STATSIONAR "Gorizont" (Russian for "horizon") spacecraft carry four types of beam antennas: global, hemispheric, zone, and spot. Russian ground control stations can select between global, hemispheric, zone, and spot beam antennas on designated transponders for maximum versatility. While INTELSAT's hemispheric and zone beams cover the eastern and western portions of the globe, the Gorizont hemispheric and zone beams are biased to maximize coverage of locations north of the Earth's equatorial region.

Gorizont satellite signal levels are more powerful than their INTELSAT counterparts. The Russian engineers who designed and built the Gorizont satellites installed 15 watt amplifiers for the global and hemispheric beams, and a 40 watt amplifier for the C-band spot beams. While the use of high power levels has given Gorizont satellites a strong and far-reaching signal, each satellite is limited to a maximum of six channels.

Gorizont satellites at 40, 53, 80, 85, 90, 96, and 140 degrees east longitude offer several channels of Russian television bound for different time zones. These satellites also extend Russian and—via the Indian Ocean Gorizont at 80 degrees east longitude—INTERSPUTNIK satellite coverage into much of Africa, Asia, and the Pacific Ocean Region. International news exchanges

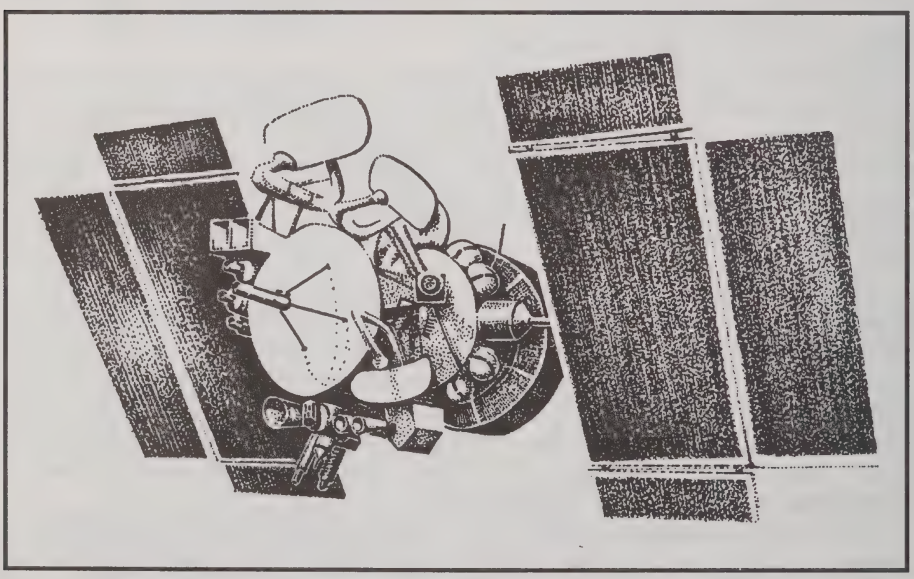


Fig.12-8. A Gorizont satellite.

involving countries such as Laos, Viet Nam, and Kampuchea can be found on the Gorizont satellite located at 80 degrees east longitude.

The Gorizont satellite at 140 degrees east longitude also carries a single experimental Ku-band spot beam transponder. Powered by 5 watt amplifiers, this 11 GHz channel eventually could be used to carry news feeds for various international broadcast organizations.

Fig. 12-9. STATSIONAR satellite deployment (As of April, 1992)

STATSIONAR-11 Status: Gorizont 11 and 15 collocated with domestic services.
Location: 11° W. [349 E.].

STATSIONAR-4 Status: Gorizont 20 with domestic, international and INTERSPUTNIK services.
Location: 14° W. [346° E.].

STATSIONAR-12 Status: Gorizont 22 with domestic and international services.
Location: 40° E. [320° W.].

STATSIONAR-5 Status: Gorizont 17 with domestic and international services.
Location: 53° E. [307° W.]

STATSIONAR-13 Status: Gorizont 16 with domestic, international and INTERSPUTNIK services.
Location: 80° E. [280° W.].

STATSIONAR-6 Status: Gorizont 13 with domestic services.
Location: 90° E. [270° W.].

STATSIONAR-8 Status: Gorizont 19 with domestic services.
Location: 95° E. [265° W.].

STATSIONAR-7 Status: Gorizont 18 with domestic services.
Location: 140° E. [220° W.].

When they are not already transmitting video signals, the active Gorizont TV transponders often display a test pattern. The spot beam (3675 MHz) transponder carries full-time TV programming from Moscow. Although the spot beam is directed over Russia, there is enough spill-over into the rest of Asia to allow home satellite TV systems there to receive the signals.

Other transponders aboard the Gorizont satellite at 80 degrees east longitude are used for one-way transmissions or "unilaterals" between INTERSPUTNIK members. Additionally, *The Asian Network* uses capacity for

Gorizont global beam coverage
(Pacific Ocean Region)

Gorizont northern hemispheric beam
coverage (Pacific Ocean Region)

Gorizont zone beam coverage
(Indian Ocean Region)

Gorizont C-band spot beam coverage
(Indian Ocean Region)

Fig.12-10. Gorizont global, hemispheric, zone and spot beam coverages.

eight hours each day to transmit television programming in English and Hindi.

Fig. 12-11. Gorizont Satellite Configuration Chart

TR No.	Freq. MHz	Beam Config.	STAT. 40° E	STAT. 80° E	STAT. 95° E	STAT. 140° E.
01	1536†	G	—	—	—	—
02	3675	S (or G)	*II Programma*	*Orbita 1 TV*	*Dub'l 2 TV*	*Orbita 1 TV*
03	3726	NH		TV Unilaterals		
04	3774	NH		Telephone		
05	3826	Z or G		TV unilaterals		
06	3876	Z or G	*CNN*	*Intersputnik/ The Asian Network/ Intervision Unilaterals*	*THVN-TV (Vietnam)*	*Dub'l 2 TV*
07	3926	Z or G	*Occ. Video*	Inactive		
08	11526	S	N.A.	N.A.	N.A.	Available

NA = Not available at this location
S = Spot Beam
H = Northern Hemispheric Beam
Z = Northern Zone Beam
G = Global Beam
† = Maritime Communications System at L-Band

Receiving International Satellite Signals

Although the global and hemispheric beams now employed by INTELSAT and STATSIONAR satellites require large dish antennas for reception, they offer one distinct advantage to home satellite TV enthusiasts. They allow spill-over reception in areas far removed from their intended destinations. The appropriate dish size will depend on what beam pattern is being used by the particular services you wish to view.

INTELSAT and STATSIONAR reception also requires some minor modifications to home satellite TV equipment to obtain high-quality performance.

Circular Polarization. For the best possible reception of INTELSAT and STATSIONAR satellites, you will need to change your feed polarity from horizontal/vertical (which is used by the Palapa and Asiasat satellites) to circular polarization. Instead of positioning the microwave energy in a plane,

whether vertical or horizontal, circular polarization is transmitted in a spiraling pattern. Although your regular feedhorn can still pick up circular polarization, you end up losing half of the available signal.

Considering the weakness of most international satellite signals, you can see that having circular polarization can make the difference between watchable video and snow city! Fortunately, special international feeds are available which can receive both linearly and circularly polarized satellite signals.

All INTELSAT and STATSIONAR satellites use right-hand circular polarization (RHCP). Left-hand circular polarization (LHCP) is exclusively used by the French Telecom birds as well as for all zone, and some spot and global beams aboard the INTELSAT V, V-A, and VI series satellites.

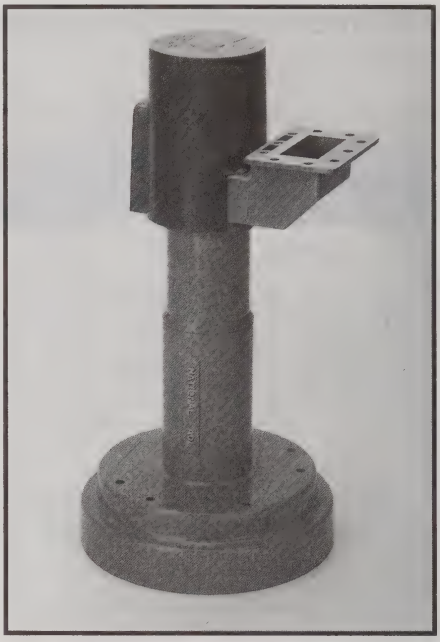


Fig.12-12. Circular/linear feedhorn. (Courtesy National ADL.)

If your feed is set to receive RHCP signals, you will be unable to see any LHCP signals, and vice versa. To receive signals of opposite polarity, an electronic servo motor must be used to electronically switch polarities.

International Satellite Frequency Scheme. The INTELSAT and STATSIONAR satellites transmit to Earth within the 3.65 to 4.2 GHz band; the number and frequencies of their C-band transponders differ somewhat from what we've seen with the North American satellite systems. Satellite TV receivers and IRDs which incorporate programmable tuning will give your system added flexibility when pulling in international signals.

Video Bandwidth. Because of the high demand for satellite time, INTELSAT (and also Palapa B2P) satellites will often squeeze two television channels, or one TV and a number of communications channels, onto any single transponder. When receiving "half-transponder" signals, it is important to have the bandwidth of the receiver narrowed to less than 20 MHz. Receivers and IRDs not modified for half-transponder reception are still capable of separately receiving each half of the channel, but at a reduced efficiency.

One way to noticeably improve satellite TV reception is to add a variable

bandwidth filter to your satellite TV system. This filter can be used to remove impulse noise or "sparklies" from your reception of the weaker international satellite TV channels. Many of today's receivers come with adjustable bandwidth filters built into them.

There is a trade-off, however. Exact reproduction of video color and detail requires that the satellite receiver process an incoming signal's total transmitted bandwidth. By narrowing the filter's bandwidth, you remove the portion of the signal that contains the greatest amount of noise. You may lose some color fidelity and picture detail, but in many cases there is still a noticeable improvement.

Selecting the Right Filter. Check your receiver's back panel to determine whether it can accept a variable bandpass filter. If the receiver has a short jumper cable linking the input and output ports of its second IF, it can accept the filter. Some receiver manufacturers also provide modifications kits for models which were not designed with IF loopthrough connections. The frequency of the filter you buy must match the IF loopthrough frequency scheme of the receiver. U.S. companies such as ESP and Phantom Engineering offer a complete line of variable bandwidth filters that can interface with the 2nd IF loopthrough frequencies used by virtually every receiver now in use.

INTELSAT Audio Encoding. The accompanying audio for any INTELSAT television transmission can be sent in many different ways. Several domestic INTELSAT transmissions use an audio subcarrier offset between 5 and 6.8 MHz, with 6.6 and 6.65 MHz the most commonly used. We recommend the use of receivers with programmable audio subcarrier tuning and selectable wide/narrow audio bandwidth filters for maximum versatility.

INTELSAT also transmits the national radio services of several countries. These radio transmissions often use an alternate audio format known as single-channel-per-carrier or SCPC. With SCPC, the audio is contained on a very narrow independent carrier frequency.

Satellite TV receivers are unable to cope with SCPC reception. There are special SCPC tuners, however, that can be used in tandem with a satellite TV receiver to provide both the audio and video reception of a given TV service using SCPC transmission techniques. For further information on SCPC reception, consult the SCPC section in chapter 9.

Audio Companding. The audio portion of the Gorizont spot beam channel's video program is on a 7.0 MHz audio subcarrier. The audio has been compressed or companded, and consequently sounds distorted on receivers not equipped to re-expand it at the receive end. The spot beam transponder's 7.5 MHz auxiliary audio subcarrier, which carries Russian radio programs, is not companded.

Energy Dispersal (ED). Energy dispersal systems insert a constantly changing waveform into the video, preventing the carrier from ever resting on its main frequency. ED also spreads the power of any transponder across its total bandwidth; this prevents the satellite transmissions from causing interference to ground-based services using the same frequencies. The ED waveform is filtered out of the video at the TVRO receiver terminal. The dispersion removal circuits used by most satellite receivers may not entirely take out the ED waveform used by Gorizont satellites. In some cases, the receiver's automatic frequency control circuit can be modified to do the job.

Tracking Inclined Orbit Satellites

Due to natural forces exerted by the Sun, the Moon, and the Earth's gravitational field, there is a natural tendency for any communications satellite to drift away from its assigned geostationary orbit. This drifting is precise and predictable and primarily is back and forth in a north/south direction. Up to 90 percent of every satellite's supply of stationkeeping fuel is used to counteract the drift so that the spacecraft can maintain its stationary position over the Earth's equator.

Many INTELSAT and most STATSIONAR satellites are operated in an inclined-orbit mode to extend the spacecraft's lifetime by preserving precious stationkeeping fuel. While the satellite's longitudinal position is being maintained within 0.1 degree of its orbital location, the spacecraft's latitudinal position can vary by more than ±3 degrees. Specially equipped antennas are needed to track the satellite's north-south drift throughout each 24-hour orbital period.

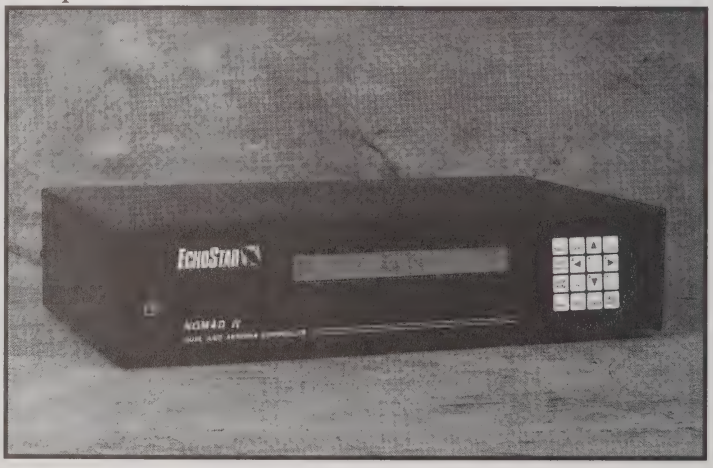


Fig. 12-13. The Echostar Nomad is a dual axis auto tracking system that features 55 prestored satellite orbital positions as well as 5 user programmable orbital locations. The unit's Adapti-drive digital servo speed control optimizes antenna movement for large antenna, dual-axis satellite tracking applications. (Courtesy Echosphere Int.)

Russian engineers allow the STATSIONAR satellites to drift in inclined orbits which vary by as much as ±3 degrees during each 24-hour period. These satellites only can be received on a continual basis by specially equipped earth stations that can track their North/South movements.

For receiving sites located at a longitude that is greater than 10 degrees from the longitude of the inclined orbit satellite, an adjustment of the antenna's elevation angle alone would not move the antenna in an angle that is perpendicular to the geostationary arc. This diagonal movement will not permit the antenna to follow the inclined satellite throughout the full period of its 24-hour orbit. Tracking from these locations will require a second motor that adjusts the declination of the antenna.

Manual control of the antenna's declination motor is the cheapest way to achieve reception of inclined orbit satellites. A manual system requires the addition of a second motor drive and connecting cable along with an actuator controller that supplies the required operating voltage to the second motor drive at the touch of a button. Depending on the size of the antenna and the level of the satellite's inclination, adjustments may be needed every couple of hours or

Fig.12-14. International satellite receiver. (Courtesy R.L. Drake Co.)

Standard Features: *150 channels may be programmed into memory with the following user programmable options: Video Frequency, IF bandwidth (16, 22, & 30 MHz), mono or stereo audio, and antenna positions. Also available: automatic signal peaking and fine tuning.*

Special Features: *PAL/NTSC/SECAM compatible with Video Noise Reduction (VNR) tuning.*

Options: *Automatic tracking of inclined orbit satellites with the ESR600e and IOA600 inclined orbit adaptor. The ESR600e is equipped to control two motor actuators on a single antenna. The receiver commands the IOA600 to select the azimuth, or the elevation, acutator to position the antenna for best reception. The inclined orbit tracking is performed automatically through a series of initial step set-up conditions during installation, or when reprogrammed by the user.*

so to keep the satellite in view. The manual solution is not recommended for home dish systems, however, because any movement of the antenna out of the normal geostationary arc can induce positioning errors that will affect normal reception of other stationary satellites.

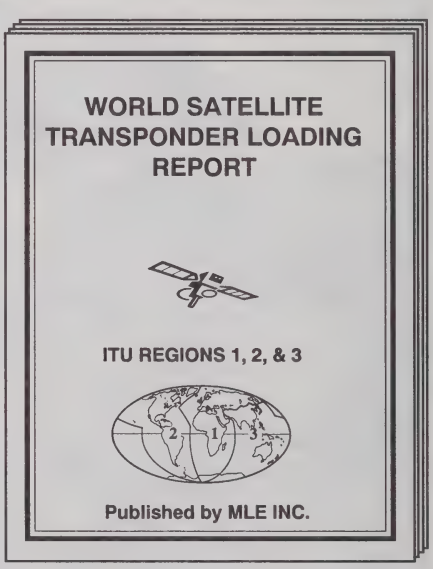
Automated control systems are available from companies such as R.L. Drake, Merrimac Satellite, and Astroguide which tap into the satellite receiver's AGC (Automatic Gain Control) signal level in order to obtain information on relative signal strength. Whenever the signal strengh falls below an established threshold level, the system's microprocessor initiates a search routine that commands the movement of the antenna's tracking system until optimum reception has once again been achieved.

Recommended Resources

Due to the rapid proliferation of satellite TV and radio services around the world, the authors cannot hope to provide a complete listing of all the available services within the limited confines of this publication. However, **MLE INC** does publish a quarterly report of what's on satellite around the world. Called *World Satellite Transponder Report,* this 102-page book will provide you with all the technical details—including video and audio frequencies, polarities, beams, and signal strength—that you need to know to receive every satellite TV and radio signal currently available via satellite.

Selected satellite footprint maps have been presented elsewhere in this chapter; others may be found in the appendices. However, the footprints provided represent only a small fraction of the total number of satellite coverage maps needed to fully understand every satellite communications system in the world.

For those readers who are in need of more detailed information, we recommend the latest edition of *The World Satellite Almanac,* where all the world's communications satellites are explained, footprinted, indexed, and analysed in detail. For more information on *The World Satellite Transponder Report* and *The World Satellite Almanac,* contact **MLE INC,** P.O. Box 159, Winter Beach, FL 32971.



Chapter 13
Future Satellite Systems for Asia and the Pacific Rim

The satellite market in Asia and the Pacific Rim is curently undergoing a growth boom, with numerous new systems competing for the attention of telecommunications providers within the region. Japan, Malaysia, South Korea, and Thailand have all announced new domestic satellite systems. Moreover, new private international satellite systems have also been announced by various U.S. companies, including Alpha Lyracom, Pacstar, TRW, Unicom, and Columbia Communications.

Existing capacity is quite limited. Asiasat has contracted for the use of all 24 transponders on its C-band satellite. The company intends to build a second Asiasat satellite for launch in 1994. INTELSAT, which already has four INTELSAT V satellites covering the region, expects to have two INTELSAT VII satellites in operation there by the year 1994, and four INTELSAT VII spacecraft in service over the POR by the year 2000. (For further details on the INTELSAT VII satellites, see chapter 12).

Thaicom Satellites (Thailand)

In 1987, the government of Thailand invited tenders for a domestic satellite system; the winner would receive a 30 year concession to lease transponders to government and private sector users, with excess capacity offered to neighboring countries. Thailand's population is about 55 million. Shinawatra Computer & Communications Group (SC&C) was awarded the satellite concession in 1991.

SC&C is the largest group of Thai companies operating various telecommunications and broadcasting service organizations, such as cable TV, cellular network, data service, paging, telephone directories, and one-way callout systems. The Thai-owned group currently operates five telecommunications concessions—Cellular 900, a paging service, a data service, IBC Cable TV, and Phonepoint.

In 1991, Shinawatra began formal negotiations with Hughes Space and Communications Group of El Segundo, California. A contract between the two organizations was signed on October 8, 1991 at around US$ 100 million for two satellites, ground equipment, and training. Deliveries of the satellites are scheduled for December, 1993, and March, 1994.

Fig.13-1. Existing Versus Future Satellite Systems for Asia & the Pacific Rim.

Existing Satellite Systems for the Pacific Ocean Region (POR)

—INTELSAT, with four INTELSAT V satellites in the POR;

—Asiasat (Hong Kong), with one satellite;

—Columbia Communications Corp. (U.S.), with commercial leasing rights to C-band capacity on two NASA Tracking and Data Relay Satellites (TDRSS);

—Palapa B (Indonesia), with two satellites.

Proposed satellite systems for the Pacific Ocean Region (POR)

—Pan American Satellite (U.S.—Alpha Lyracom), with two spacecraft: 192 and 72 degrees west longitude;

—Measat (Malaysia), with one spacecraft: To be decided;

—Pacificom (U.S.), with one spacecraft: 172 degrees east longitude;

—Pacstar (Papua New Guinea), with two to four spacecraft: 167.45 degrees east longitude and 175 degrees west longitude;

—Koreasat (South Korea), with one spacecraft: To be decided;

—Thaicom (Thailand), with two spacecraft: 101 & 78.5 degrees east longitude;

—Tongasat (Republic of Tonga), with four spacecraft: 83.3, 130, 134, and 142.5 degrees east longitude;

—Unicom (U.S.), with two spacecraft: 170.75, 138 degrees east longitude.

—Palapa Pacific (Indonesia) with one inclined orbit spacecraft with beam directed over the Pacific Ocean: location to be determined.

On December 6, 1991, SC&C signed a launch contract with Arianespace for the launch of Thailand's first satellite to 101 degrees east longitude. The launch contract for a second satellite to be located at 78.5 degrees east longitude had not been awarded at the time of writing. On December 17, 1991 His Majesty King Bhumiphol officially named the satellite system "Thaicom", which symbolizes the link between Thailand and the communications technology. The two Thaicom satellites will have a mission lifetime of 13 to 15 years.

Thaicom Communications Payload

Each Thaicom satellite will carry 10 C-band and two Ku-band transponders. The 36-MHz-wide C-band transponders, which will be powered by 11 watt solid-state amplifiers (SSPAs), will produce a minimum EIRP of 37 dBW

over Thailand and 35 dBW at beam edge. The satellite's C-band footprint will include Thailand and all other Indo-China countries, Korea, Japan (including Tokyo), and the east coast of China (including Beijing). The 54-MHz-wide Ku-band transponders, which will be powered by 50-watt travelling wave tube amplifiers (TWTAs), will produce a minimum EIRP of 50 dBW over Thailand. (Refer to the conversion chart in Appendix A to see how to convert EIRP in dBW to equivalent dish sizes.)

Thaicom Communication Services

As part of the concession award, all Thailand-based broadcasters and communications companies now using INTELSAT, Asiasat, and Palapa satellites will be required to move their services to Thaicom satellites upon the expiration of their current contracts. These services include the five national Thai TV broadcast networks (Channels 3, 5, 7, 9, & 11), Radio Thailand, Compunet, and Samart Telecom.

Moreover, SC&C intends to use the Thaicom satellites to transmit numerous entertainment channels directly to Thai homes; these services presently are transmitted terrrestrially in major urban areas using multichannel

Fig.13-2. Thaicom satellite (Courtesy Shinawatra.)

multipoint distribution service (MMDS) frequencies. The use of digital video compression is being contemplated to make maximum use of the two satellites' medium-powered Ku-band transponders.

SC&C presently owns and operates a three-channel MMDS service called IBC Cable TV. IBC-1—the all-news channel—receives programming from leading news agencies in the U.S. (CNN, ABC, CBS, & PBS), the U.K. (BBC and ITN), Europe (VISNEWS), and Japan (NHK Japan Broadcasting). The programming includes 20 hours a day from CNN.

IBC-2 is an entertainment channel which provides sports broadcasts contributed by ESPN and the BBC. Other entertainment programs include films, mini-series, talk shows, game shows, situation comedies, music videos, concerts, cartoons, and other specialty shows.

IBC-3 features a variety of programs produced in Thai, Chinese, and English, including news, sports and other entertainment. Shinawatra's future plans include increasing the number of available channels and using the Thaicom satellites to expand the IBC Network throughout all of Thailand

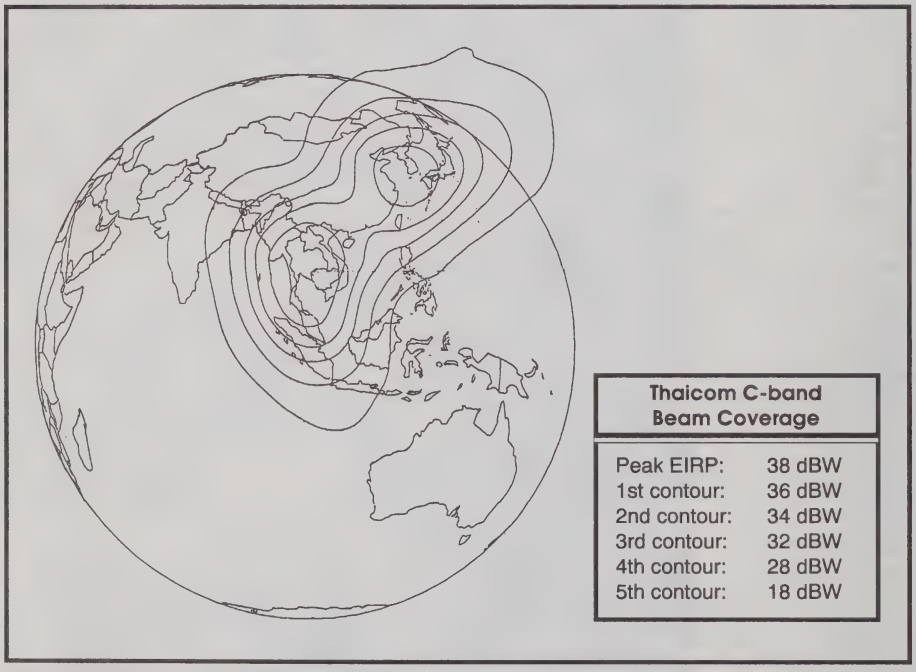
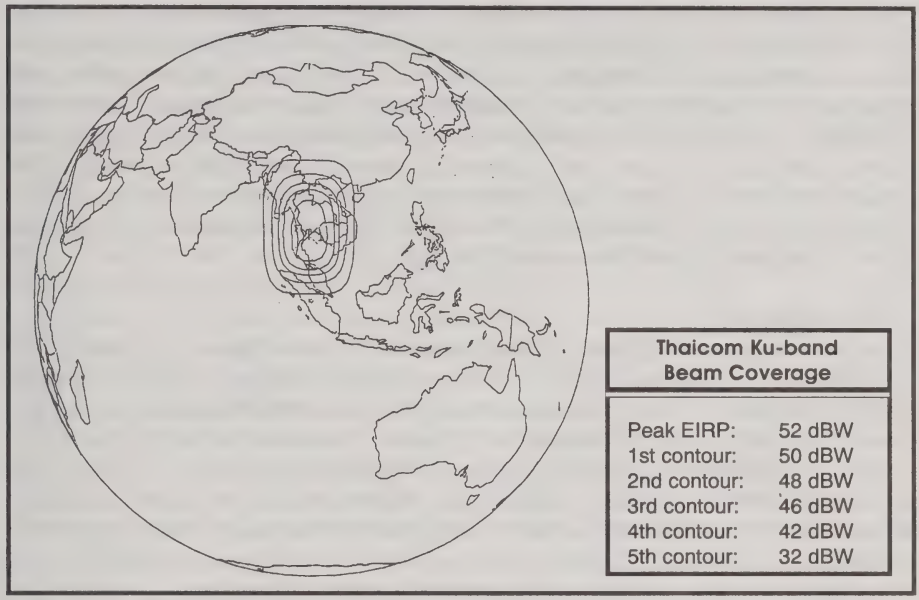


Fig.13-3. Thaicom A1 C-band satellite coverage from 101.5 degrees east longitude.

Fig.13-4. Thaicom A1 Ku-band satellite coverage from 101.5 degrees east longitude.



and possibly into other southeast Asian countries as well.

A second Thailand-based MMDS service called Thai Sky TV also is contemplating the use of Thaicom satellites for direct-to-home distribution of its three-channel service. Thai Sky TV presently provides news and sports (Channel 1), movies, music videos, and other English-language entertainment (Channel 2), and Thai-language movies, documentaries, and other locally-produced entertainment (Channel 3).

The principal voice and data use of the two Thaicom spacecraft will be for domestic telephone, and also video, voice, and data services for communications on behalf of private business and governmental groups. The types of traffic envisioned include mobile and cellular phone systems.

Measat (Malaysia)

Malaysia is seeking bids for that country's first domestic satellite system. Malaysia presently spends about 30 million dollars each year to lease satellite capacity from INTELSAT and Indonesia's Palapa B satellite system. Malaysia already has held talks with launch service providers in the United States and the People's Republic of China concerning the possible launch of the first Malaysian satellite in 1995.

Koreasat (South Korea)

A new domestic satellite system for South Korea is being manufactured by Matra Marconi Space U.K., in partnership with GE Astro Space of the United States. Two Koreasat communications satellites currently are under construction. These satellites will be used to beam direct broadcast television, business, and general communications services to locations throughout Korea. The total system cost for Korea's domestic satellite system will be about US$ 140 million. The communications payload will consist of 18 transponders: 12 C-band, and 6 Ku-band, three of which will be used for direct-to-home TV and radio broadcasting.

N-STAR (Japan)

Japan's Nippon Telegraph & Telephone has selected Space Systems/Loral of Palo Alto, California to build its next generation "N-Star" satellite system. The two Japanese N-Star satellites will operate in the C, Ka, Ku, and L bands, providing both fixed and mobile satellite services within Japan. Loral will draw upon state-of-the-art technology already being used by the company in the construction of the INTELSAT VII series of telecommunications satellites. Under the terms of the US$ 600 million contract, Space Systems/Loral "shall be required to manufacture, launch, and place the satellites into geostationary orbit in operable condition, after administering verification tests on the functions and performance of the satellites."

The two N-Star satellites will be used to replace NTT's CS-3A and CS-3B satellites which currently transmit voice and data traffic from 132 and 136 degrees east longitude respectively. N-Star A is scheduled to be delivered in orbit on or before April 30, 1995. N-Star B will follow on or before October 31, 1995. Arianespace will supply the launch vehicles for both satellites.

Space Systems/Loral was established by the Loral Corporation in 1990 when it purchased Ford Aerospace from the Ford Motor Company. Ford Aerospace previously was involved in the development of the Japanese CS series of satellites for NTT. The N-Star spacecraft are expected to achieve an orbital lifetime of ten years.

Palapa Pacific (Indonesia)

Pasifik Satelit Nusantra (PSN) of Jakarta, Indonesia, has purchased an aging Palapa B satellite from the Indonesian government. The Palapa B1 satellite, which has been renamed the Palapa Pacific System, will provide users in the Pacific Ocean Region with low-cost satellite capacity that can support a broader range of telecommunications services.

As of 1992, Palapa B1 had a remaining estimated service life of about three

years provided that the satellite is operated in an inclined orbit. The satellite will be operated in conjunction with a special proprietary orbiting technique developed by the U.S. Comsat Corporation called the "Comsat Maneuver". This technique is used by the INTELSAT and ARABSAT organizations to extend the mission lifetimes of older satellites which have little stationkeeping fuel remaining. (See Chapter 12 for further information about inclined orbits and how to track them.).

Palapa Pacific is expected to begin operations in 1992. Continuity will be provided by existing Palapa satellites either from the remaining Palapa B series and/or the next generation of Palapa satellites scheduled to be launched by Indonesia beginning in 1995.

Potential customers include companies in Japan, South Korea, the Philippines, and several Pacific Island nations. No orbital position had been allocated at the time of writing, but the satellite has been allowed to drift towards a location above the Earth's equator between 135 and 145 degrees east longitude. PSN anticipates no problem with the move, and intends to purchase the remaining four satellites of the Indonesian Palapa B series once they have reached the end of their conventional mission lifetimes.

Services that can be offered using the Palapa Pacific System include TV

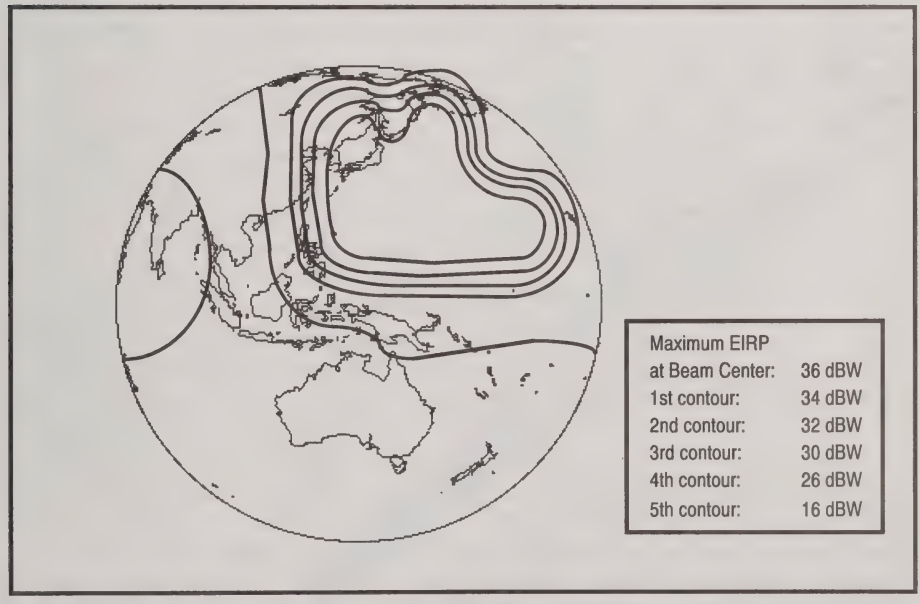


Fig.13-5. Possible Palapa Pacific Coverage from 135° east longitude (hypothetical projection).

broadcast distribution, satellite news gathering, private video, voice, and data networks, low cost rural telecommunications, region-wide information data collection and distribution systems, and national or regional telephone links.

Palapa Pacific's single beam design will allow straightforward interconnectivity between any location within the coverage area. This will permit not only domestic applications for individual countries, but also full international links, networks, and services. Indonesia's state-owned telecommunications company, PT.Telekom, will continue to operate the system. (PT. Telekom is a majority shareholder in Pasifik Satellite.)

The PacStar Satellite System (Papua New Guinea)

On February 17, 1992, Pacific Satellite Inc., an international satellite system proposed by the government of Papua New Guinea, the U.S. Pacific Telecom corporation, Alascom, and various Hong Kong-based ventures, issued a Request For Proposals (RFP) for the manufacture of its two "Pacstar" satellites for the Pacific Ocean Region. A manufacturing contract is expected to be awarded by mid-1992 and an initial launch has been reserved with

Fig.13-6. PacStar Satellite Coverage Zones

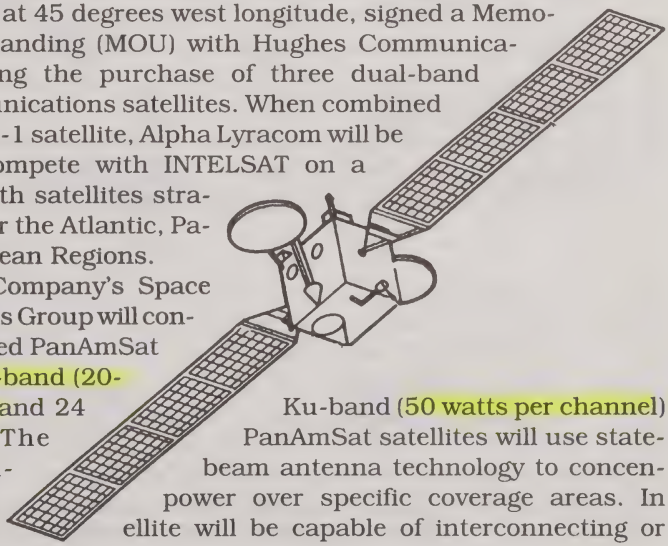
Arianespace for late 1994 or early 1995. Discussions also are underway concering possible use of a Chinese Long March or a McDonnell Douglas Delta to meet the company's on-going launch requirements.

Pacific Satellite also is awaiting the completion of a World Bank study that among other things will help the company determine whether two large-scale satellites should be built, or a series of smaller "Lightsats" instead. If a traditional design is chosen, PacStar I will provide a minimum of 22 transponders; the selection of a Lightsat design approach would slim PacStar's communications payload down to a 10 to 12 transponder package. The main advantages of procuring a Lightsat are the initial cost savings for construction and launch and the lower manufacturing lead time (20 to 24 months versus 28 to 30 months).

In 1987, Pacific Satellite, Inc. was assigned two orbital locations by the ITU's International Frequency Registration Board: 167.45 degrees east longitude and 175 degrees west longitude. From these orbital locations the Pacstar satellites will transmit highly concentrated spot beams that will interact with very small aperture terminals (VSATs) and other low-cost, two-way earth stations as well as gateway terminals and VSAT central control or "hub" stations.

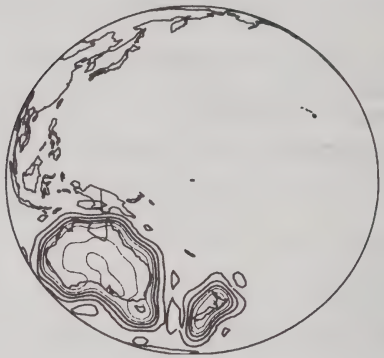
PanAmSat (Alpha Lyracom/United States)

In August of 1991, Alpha Lyracom, owner of the Atlantic Ocean PAS-1 satellite stationed at 45 degrees west longitude, signed a Memorandum of Understanding (MOU) with Hughes Communications, Inc. governing the purchase of three dual-band "PanAmSat" communications satellites. When combined with its existing PAS-1 satellite, Alpha Lyracom will be in a position to compete with INTELSAT on a worldwide basis, with satellites strategically located over the Atlantic, Pacific, and Indian Ocean Regions.

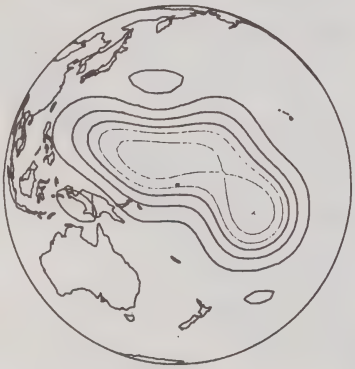


Hughes Aircraft Company's Space and Communications Group will construct three advanced PanAmSat satellites with 24 C-band (20-watts per channel) and 24 Ku-band (50 watts per channel) transponders. The PanAmSat satellites will use state-of-the-art shaped-beam antenna technology to concentrate satellite power over specific coverage areas. In addition, each satellite will be capable of interconnecting or

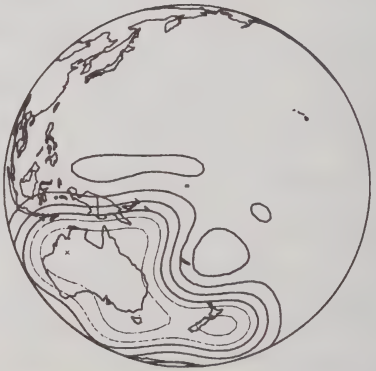
PAS Malay Beam
(Pacific Ocean Region)



PAS Ku-band Australian Beam
(Pacific Ocean Region)



PAS Pacific Beam
(Pacific Ocean Region)



PAS C-band Australian Beam
(Pacific Ocean Region)

Fig.13-7. PanAmSat Pacific Ocean Coverage Beams from 166/168 degrees east longitude.

"cross-strapping", on command—from Ku-band to C-band and from C-band to Ku-band—on a transponder-by-transponder basis.

The projected mission life of the PanAmSat satellites will be 12 years. Construction on the satellites began in August of 1991, with delivery of the first satellite scheduled for the first quarter of 1994. The second and third satellites are scheduled to be delivered in the third and fourth quarters of 1994, respectively.

PacifiCom-1 (TRW/United States)

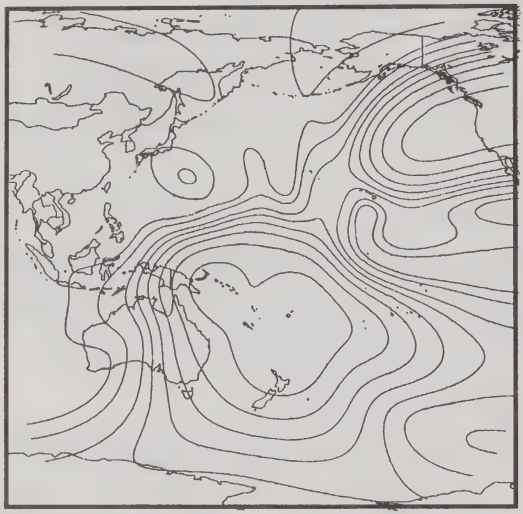
On August 28, 1991, TRW Inc. of the United States requested authority from the U.S. Federal Communications Commission (FCC) to construct, launch, and operate a private international satellite to be known as PacifiCom-1, a hybrid C- and Ku-band communications satellite to be located at 172 degrees east longitude for the provision of international, regional, and foreign domestic satellite services.

Provided that FCC approval is granted in the near future, TRW expects to launch and initiate service on PacifiCom-1 by the fourth quarter of 1994. The satellite will be equipped with eight medium-power C-band transponders and eleven medium-power Ku-band transponders. The PacifiCom-1 satellite, which will have a mission lifetime of 12 years, will provide two-way Ku-band services between the west coast of the U.S. and selected Asian nations, and two-way C-band services between North America, Asia, and the nations of the South Pacific, including Australia and New Zealand.

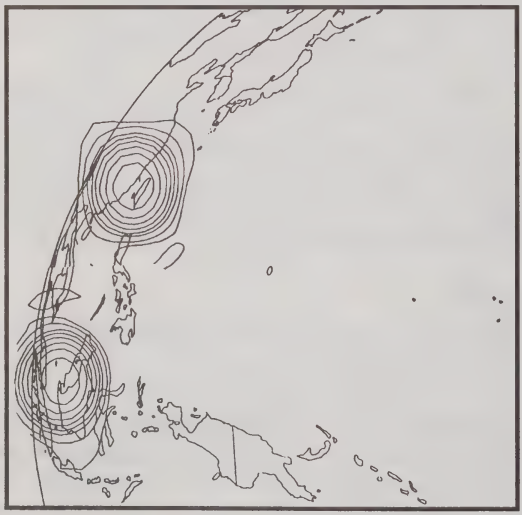
PacifiCom-1 will be the first of two collocated spacecraft at the 172 degrees east longitude orbital location. When TRW achieves its internal business goal of advance leases and sales of transponder capacity for PacifiCom-1, it expects to file an application for a collocated companion satellite at 172 degrees east longitude—PacifiCom-2—which will be identical to the first except for its use of an opposite polarization format.

Pacificom Service Description

PacificCom-1 also will be used for the provision of foreign domestic and foreign regional satellite communications services. TRW intends to sell or lease the satellite's capacity to users within the region. Ku-band services will include the direct-to-home transmission of standard video and high definition television signals, private data and voice networks, private computer networks, and video teleconferencing services. PacifiCom-1's C-band transponders will be used for commercial TV program collection and distribution, as well as high-speed data communications, including facsimile, two-way video teleconferencing, and wideband digital services.



PacifiCom South C-band Beam	
Peak EIRP:	37.7 dBW
1st contour:	35.7 dBW
2nd contour:	33.7 dBW
3rd contour:	31.7 dBW
4th contour:	29.7 dBW
5th contour:	27.7 dBW
6th contour:	25.7 dBW
7th contour:	21.7 dBW
8th contour:	17.7 dBW



PacifiCom Asian North & South Ku-band Beams	
Peak EIRP:	56 dBW
1st contour:	54 dBW
2nd contour:	52 dBW
3rd contour:	50 dBW
4th contour:	48 dBW
5th contour:	46 dBW
6th contour:	44 dBW
7th contour:	40 dBW
8th contour:	36 dBW

Fig.13-8. PacifiCom C- and Ku-band beams.

The Unicom Satellite System & Tongasat

On November 23, 1991, the American-based Unicom Corporation announced the signing of an Agreement with the Kingdom of Tonga under which Unicom is authorized to operate satellites in two (170.75 and 138 degrees east longitude) of Tonga's six orbital positions registered with the ITU's International Frequency Registration Board (IFRB). Under the agreement, Unicom also holds options on other Tonga orbital positions as required.

Unicom further announced that it had signed a contract to purchase two satellites from U.S.-based Fairchild Space and Defense, now a member of the French Matra Group.

Each Unicom satellite will carry 12 C-band (20-watt SSPAs) transponders and 6 Ku-band (50 watt TWTAs) transponders. All transponders can be cross-strapped by ground command to provide C-band to Ku-band, Ku-band to C-band, C-band to C- band *and* Ku-band, and Ku-band to Ku- band *and* C-band connectivity. Footprint coverage has been designed to allow service into 3m antennas using C-band frequencies and 1.8m antennas using Ku-band frequencies.

Unicom satellites will carry a mix of video, data, private television, and videoconferencing services operating in either a digital or analog mode. Unicom is considering several locations in southeast Asia in which to locate a Telemetry, Tracking, and Relay (TT&C) facility capable of controlling multiple satellites. Unicom also has made a launch reservation with McDonnell Douglas for a Delta II rocket launch for its first Unicom satellite.

The TDRSS Satellite System (Columbia Comm./United States)

Through a long-term lease with the U.S. National Aeronautics and Space Administration (NASA), Columbia Communications Corporation of Honolulu, Hawaii has acquired control over all of the international C-band capacity on NASA's in-orbit TDRSS satellites over the Atlantic (41 degrees west longitude) and Pacific (174.3 degrees west longitude) Ocean Regions. The satellites have been tested and Columbia has received all required U.S. licenses for international operation, with commercial service slated to begin by mid-1992.

Columbia's Pacific Ocean Region transponders can provide video, data, and private line telecommunications services between the contiguous United States and all major population centers of Asia from Hong Kong on north. The Atlantic TDRSS satellite reaches all of Europe, including Eastern Europe, Scandinavia, and the Mediterranean. The two beams of the Atlantic and Pacific Ocean TDRSS satellites overlap in the central United States, enabling Columbia to link major population centers as far east as Istanbul, Turkey to U.S. locations, and from the United States to major cities as far west as Beijing, China.

TRW, applicant for the previously-mentioned PacifiCom satellite system, has become Columbia Communications Corporation's anchor tenant for commercial transponder capacity on both of the TDRSS satellites. The companies intend to jointly market international services on the TRW-leased transponders over the Pacific Ocean. TRW, which has signed a six-year lease with Columbia for these transponders, will use the capacity to provide video, data, and private line telecommunications services. This multiple transponder lease with Columbia will allow TRW to immediately begin a PacifiCom-type communications service to Pacific Rim countries north of the equator and permit a transition to full PacifiCom service in 1995.

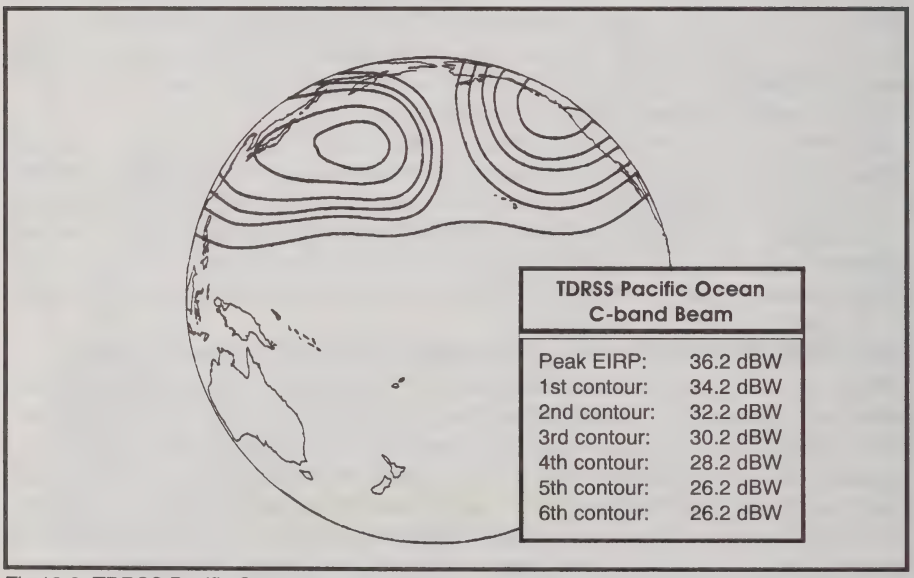


Fig.13-9. TDRSS Pacific Ocean beam coverage.

Chapter 14

Satellite TV In The Middle East

Asiasat 1 and the ARABSAT satellites stationed at 26 and 31 degrees east longitude can provide satellite TV viewers in the Middle East with more than a dozen channels of television. In many locations, these services can be received by antennas which are less than 15 feet (4.5m) in diameter. Additional satellite TV channels are available from the international INTELSAT and STATSIONAR satellites as well as the European EUTELSAT and ASTRA spacecraft. Larger antennas in the 15 to 25 foot range (4.5 to 7.5m) are usually needed to receive these additional satellite TV services.

Asiasat

The Southern Beam of the Asiasat satellite was designed to provide high signal levels throughout the Gulf States and as far west as Turkey, Cyprus and portions of Egypt. The table below identifies the respective power level

ASIASAT EIRP AND AZ/EL COORDINATES

Country	EIRP Range	Major City	EIRP	TVRO†	Elevation	Azimuth
Iran	32~36 dBW	Tehran	35 dBW	2.4m	21	113
Iraq	31~33 dBW	Baghdad	33 dBW	3m	16	107
Kuwait	33 dBW	Kuwait	33 dBW	3m	20	107
Saudi Arabia	21~33 dBW	Riyadh	30 dBW	6m	20	104
Bahrain	34 dBW	Bahrain	34 dBW	3m	24	108
Qatar	33~35 dBW	Doha	35 dBW	2.4m	24	107
UAE	34 dBW	Abu Dhabi	34 dBW	3m	27	108
Oman	27~35 dBW	Muscat	35 dBW	2.4m	32	107
Jordan	30~32 dBW	Amman	31 dBW	6m	8	101
Syria	31~33 dBW	Damascus	34 dBW	3.7m	9	102
Lebanon	32 dBW	Beirut	32 dBW	5m	6	100
Turkey	31~33 dBW	Ankara	31 dBW	6m	4	101
Israel	30~32 dBW	Tel Aviv	31 dBW	6m	7	100
Egypt	25~31 dBW	Cairo	30 dBW	6m	5	98
Cyprus	31 dBW	Nicosia	31 dBW	6m	6	101

† Recommended TVRO antenna sizes in meters

SOURCE: Asiasat Satellite Telecommunications Co., Ltd.

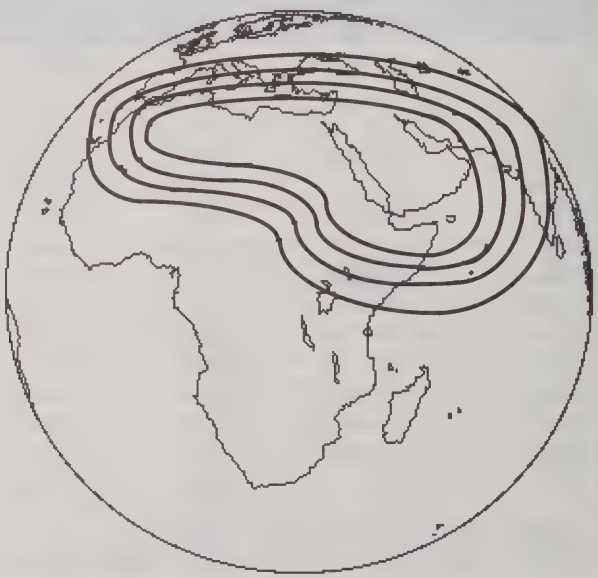
(EIRP) and elevation/azimuth coordinates for major cities throughout the Middle East. To determine the correct antenna size for individual locations throughout the region, refer to the chart which appears at the beginning of Appendix A.

ARABSAT

The Arabian Satellite Communications Organization (ARABSAT) was founded in 1976 by the League of Arab States. At the time of writing, two ARABSAT C-band satellites were located at 26 degrees and 31 degrees east longitude. Neither of the ARABSAT satellites are visible from the Pacific Rim or most areas of Asia.

Each ARABSAT satellite carries 25 C-band transponders. Each satellite's circularly-polarized C-band spot beams are directed toward the Arab states of Northern Africa and the Middle East with coverage extending as far east as the Indian subcontinent. Full-time C-band TV traffic on ARABSAT includes single services from Mauritania, Morocco, and Oman, two channels from Saudi Arabia, four channels from India, and CNN International. Occasional video transmissions via the Arabsat News Exchange transponder also provide news, sports, and entertainment feeds on a daily basis.

Fig. 14-1. Arabsat I-B Spot Beam Coverage from 26 degrees east longitude



C-band EIRP	
Beam Center:	35 dBW
1st contour:	33 dBW
2nd contour:	31 dBW
3rd contour:	29 dBW
4th contour:	27 dBW

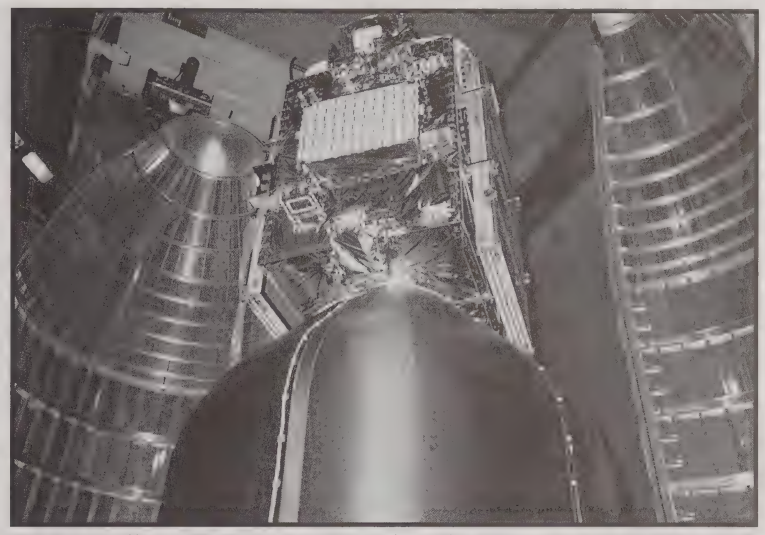


Fig.14-2. An Arabsat satellite prior to launch, mounted on the summit of the Sylda dual launch system used by Arianespace. (Courtesy Aerospatiale.)

Each ARABSAT satellite also carries 2 S-band transponders (1.6 GHz) which can be used for direct-to-home services. TV Egypt and the Middle East Broadcasting Centre (MBC), an Arabic-language TV service which originates out of London, England, transmit their services trough S-band transponders on the ARABSAT 1-B and 1-C satellites located at 26 and 31 degrees east longitude.

Reception of S-band satellite transmissions requires the use of special satellite reception equipment. Existing C-band satellite dishes can be modified to receive S-band signals through the addition of an S-band feedhorn and LNB. This S-band LNB will provide a standard IF output signal that can be processed by virtually all C- or Ku-band satellite TV receivers.

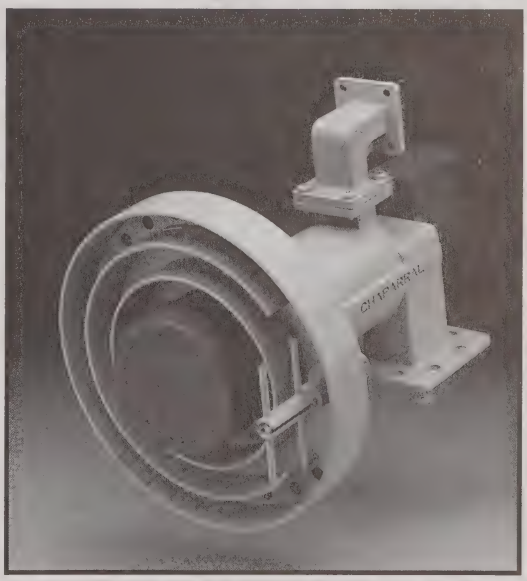


Fig.14-3. Triple band (S, C, & Ku) international feed. (Courtesy Chaparral Communications.)

Fig.14-4. A C-band yagi array. (Courtesy Space & Scientific Ltd.)

Alternatively, if the user is content to limit reception solely to the available S-band satellite TV services, another type of antenna that is similar in appearance to most terrestrial TV antennas may be used. In 1991, Britain's Space and Scientific Ltd. developed a special type of S-band antenna called a yagi which can be used in place of a satellite dish to receive Arabsat's S-band TV services. In recent months, Space & Scientific's C-band yagi antennas have also become available for reception of satellite TV programming carried by the Asiasat and Arabsat satellites.

The yagi antenna is similar to normal terrestrial antennas for VHF or UHF TV reception. The design differs in that the elements become very small as the frequency gets higher. At S-band (2.5 GHz), for example, the elements are about 2cm in diameter. The supporting boom which holds the elements in place also is significantly longer than most terrestrial TV antennas up to 3.1 meters in length for some models. Whenever additional antenna gain is required, multiple yagi antennas can be combined together to provide a higher signal level.

The EUTELSAT European Communications Satellites

The EUTELSAT satellites are owned and operated by the European Telecommunications Satellite Organization (EUTELSAT), a 28-nation satellite cooperative with its headquarters in Paris, France. EUTELSAT was established in 1977 by members of the European Conference of Postal and Telecommunications Administration (CEPT).

Eutelsat I satellites. On June 26th, 1983, the first of a series of commercial European communications satellites was launched by the European Space Agency from its facilities in Kourou, French Guiana. EUTELSAT I F1 was the result of an intensive effort by the European community to establish a regional communications network for the relay of telephone, television, and data signals between diverse locations throughout the continent. EUTELSAT I F1 was retired from service in 1991.

Three additional EUTELSAT I series satellites (F2, F4, and F5) were launched during the 1980s. As of May 1, 1992, all three satellites were operational. However, none of these satellite have footprints that cover locations in the Middle East.

Eutelsat II satellites. Europe's evolving telecommunications needs led EUTELSAT to design its second generation satellites to accommodate an ever growing universe of small-aperture satellite TV systems that serve both the commercial and home satellite TV marketplaces. As of May 1, 1992, three EUTELSAT II satellites already were in orbit, with three additional spacecraft scheduled for launch in 1993 and 1994. Eutelsat II satellites, which use the 10.95 ~ 11.20, 11.45 ~ 11.70, and

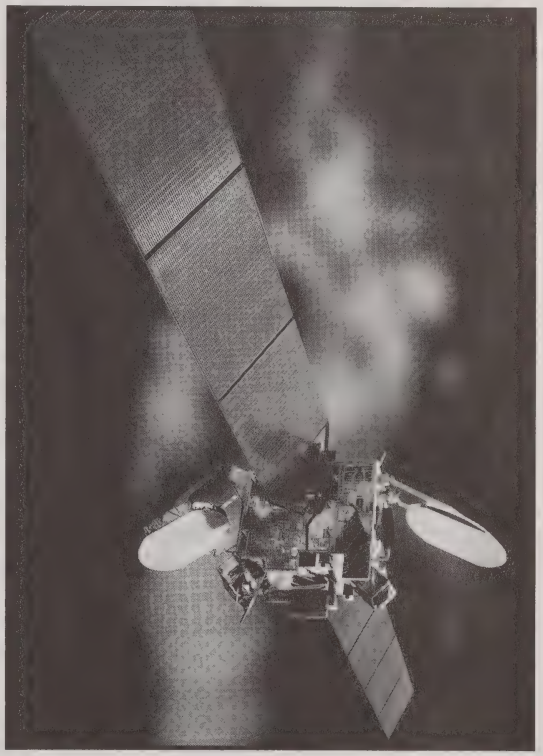
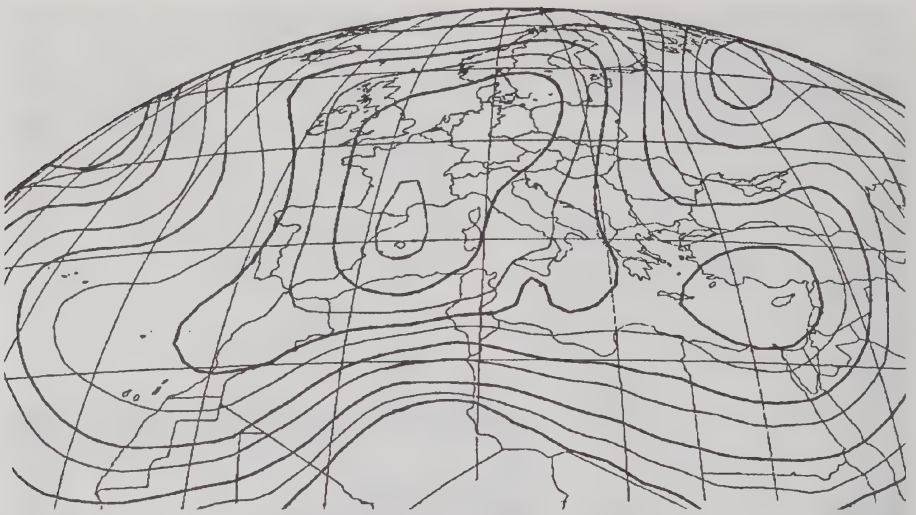


Fig.14-5. A Eutelsat II satellite. (Courtesy Space Systems/Loral.)



1st contour:	48 dBW	6th contour:	42 dBW
2nd contour:	47 dBW	7th contour:	40 dBW
3rd contour:	46 dBW	8th contour:	36 dBW
4th contour:	45 dBW	9th contour:	32 dBW
5th contour:	44 dBW	10th contour:	28 dBW

Fig.14-6. Eutelsat II Widebeam Coverage from 13 degrees East Longitude

12.50 ~ 12.75 GHz frequency bands, can operate 16 transponders simultaneously. Each satellite carries eleven horizontally and eleven vertically polarized transponders (on the downlink), with bandwidths of 31, 36, and 72 MHz.

Each EUTELSAT II spacecraft carries two transmit antennas. The *Widebeam* provides a large European-wide coverage from Iceland to Turkey, and from Finland to the Canaries and the Azores. The coverage also includes northern Africa and portions of the Middle East. This beam is used to relay telephony, business communications, and TV transmissions. Widebeam channels can be received by antennas that are 90 cm (3 ft.) in diameter within an area stretching from Madrid in the south, to Stockholm in the north and Istanbul in the east. Other outlying locations must use a larger antenna.

The *Superbeam* provides coverage of the central portion of the continent, including outlying regions such as southern Spain and the northern portion of the Scandinavian countries. Because of the Superbeam's high level of concentration, Eutelsat II TV services using this coverage beam cannot be received from most locations in the Middle East.

Fig.14-7. Eutelsat II Widebeam Satellite TV and Radio Program Services (as of April, 1992).

Widebeam TV Services:	*Widebeam Radio Services:*
Super Channel (U.K.)	BBC World Service (U.K.)
TV 5 (France)	Voice of America (U.S.A.)
Worldnet (U.S.A.)	Onda Cero (Spain)
One World Channel (Norway)	SER 50 Principales (Spain)
Antenna Tres (Spain)	Cadena SER (Spain)
Canal Plus España (Spain)	EFE Radio Madrid (Spain)
Tele Cinco (Spain)	Cadena Cope (Spain)
TV Plus (Holland)	RNE Radio Una (Spain)

ASTRA Satellites

ASTRA is the private satellite project developed by Luxembourg's Société Europénne des Satellites (SES). Manufactured by GE Astro-Space, the ASTRA satellites are medium-powered spacecraft similar to the Satcom K satellites now in use in the U.S. Carrying 50-watt traveling wave tube amplifiers, ASTRA 1-A and 1-B are capable of providing quasi-DBS services to European home dish antennas as small as 60 cm (23 inches) in diameter. As of May 1, 1992, the two satellites were collocated at 19.2 degrees east longitude; these satellites will be joined by two additional ASTRA spacecraft (1-C and 1-D) which are scheduled to be launched in 1993 and 1994.

The ASTRA 1-A satellite's primary coverage area includes England and Wales, Germany, Switzerland, Belelux, and France, while ASTRA 1B has an expanded coverage zone that has been extended to include most of Spain and Italy. Within these key markets, 60 cm antennas provide adequate reception.

Although the ASTRA satellite footprint maps show no signal reaching the Middle East, recent reports indicate that the Sky News and Eurosport TV services relayed by the ASTRA 1-A satellite can be received in Israel, Northern Egypt, Jordan, and as far down as the city of Tabük in northern Saudi Arabia by antennas as small as 16 feet (5m) in diameter. This unintended coverage beyond the satellite's normal footprint is often referred to as "spill over".

All of the 16 channels aboard ASTRA 1-A transmit within the 11.200~11.450 GHz frequency band, while ASTRA 1-B's sixteen channels transmit within the 11.450 ~11.700 GHz frequency range. Once launched, ASTRA 1-C will use the 10.95 ~ 11.2 GHz frequency spectrum, giving SES the ability to provide a total of 48 channels from a single orbital position. ASTRA 1-D, which will serve as a back-up spare in the event that it isn't needed to replace one of the other satellites in the system.

INTELSAT Satellite Reception in the Middle East

There also are dozens of TV services relayed by the Atlantic and Indian Ocean INTELSAT satellite which can be received throughout the Middle East. The available Atlantic Ocean C-band services which as of early 1992 were unencrypted include: Canale Horizon (France), TV Libya, NTA (Nigeria), Worldnet (United States), RTG (Gabon), and Tele-Sahel (Niger). Unscrambled Indian Ocean INTELSAT services on C-band include: Algerian TV, TV Sudan, TV Zaire, M-Net (South Africa), Canale France, and Worldnet (U.S.A.). Reception of most of these INTELSAT TV services requires antennas in the 5 to 7.5 meter range.

INTELSAT also provides international broadcasters with access to global beams that can reach any location within view of the satellite—up to 40 percent of the Earth's surface. Each day numerous "occasional video" news and sports feeds can be found by fine tuning the receiver center frequency settings for channel 23 (4.166 GHz) or channel 24 (4.188 GHz) on the INTELSAT satellites stationed at 60 and 63 degrees east longitude and 334.5, 342, and 359 degrees east (24.5, 18, and 1 degree west) longitude. However, because the global beam covers such a vast area, the signals are weaker than their hemispheric and zone beam counterparts. Many of these transmissions also are sent in a half-transponder format at a reduced power level. For these reasons, antennas ranging from 25 to 33 feet (7.5 to 10m) in diameter must be used to obtain high quality signals. (See Chapter 12 for more information on how to receive INTELSAT satellite TV transmissions.)

INTELSAT satellites over the Atlantic and Indian Oceans also carry Ku-band transponders which are used by Iran, Israel, Italy, and Turkey to transmit a dozen full-time TV services. All of these channels can be received from locations in the northern portion of the Arabian peninsula. (For further details on frequencies and estimated signal strength for the individual C- and Ku-band services, refer to appendix C.)

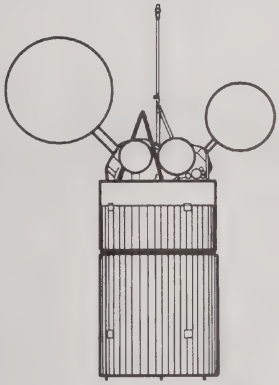
Fig. 14-8. Available INTELSAT Ku-band Spot Beam Services in the Middle East

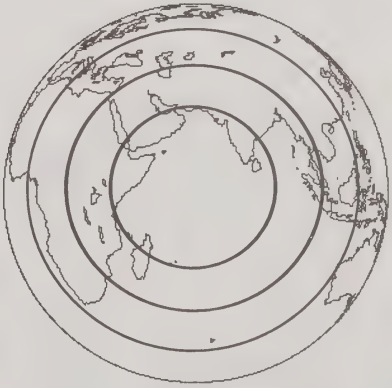
Israel TV-1, TV-2, & TV-3	INTELSAT (AOR)	1° west longitude
IRIB-1 & IRIB-2 (Iran)	INTELSAT (IOR)	63° east longitude
TRT-1, TRT-2, TRT-3, & TRT-4 (Turkey)	INTELSAT (IOR)	60° east longitude
ReTe 4, Italia 1, & Canale 5 (Italy)	INTELSAT (IOR)	63° east longitude

Fig.14-9. INTELSAT VI C-Band global, hemispheric, and zone beam coverage zones

ATLANTIC OCEAN REGION
WEST & EAST HEMISPHERIC,
& NW, SW, NE, & SE ZONE
BEAM COVERAGE AREAS

INDIAN OCEAN REGION
WEST & EAST HEMISPHERIC,
& NW, SW, NC, & E ZONE
BEAM COVERAGE AREAS





INDIAN OCEAN REGION
GLOBAL BEAM COVERAGE

STATSIONAR Coverage of the Middle East

STATSIONAR satellites stationed over the Atlantic and Indian Oceans transmit more than a dozen channels of TV that can be received throughout the Middle East by satellite TV systems equipped with antennas ranging from 10 to 20 feet (3 to 6m) in diameter. The available regular program services include various time zone versions of Moscow's first and second channels (I and II Programma), CNN International, the Asian Network, the African Channel, TV Cubana, and TV Mozambique. International news and

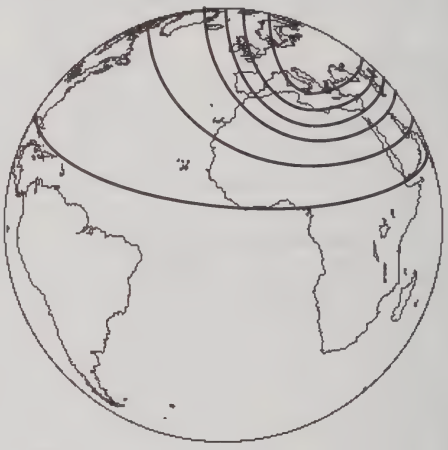


Fig. 14-10. Statsionar 4 C-band Spot Beam Coverage from 14 degrees west longitude (I Programma, Moscow)

Maximum EIRP at	
Beam Center:	46 dBW
1st contour:	45 dBW
2nd contour:	43 dBW
3rd contour:	41 dBW
4th contour:	36 dBW
5th contour:	26 dBW
6th contour:	16 dBW

Fig. 14-11. Statsionar 4 Global Beam Coverage from 14 degrees west longitude (Including Intervision news feeds, the African Network, & TV from Cuba.)

Maximum EIRP at	
Beam Center:	29 dBW
1st contour:	28 dBW
2nd contour:	27 dBW
3rd contour:	26 dBW

sports feeds, including the daily Intervision news exchange between broadcasters within the various INTERSPUTNIK member countries, also are available. The Russian-language programs are very popular in Israel, where a large community of Russian expatriots now lives. (See chapter 12 for more information on how to receive STATSIONAR satellite signals.)

Fig. 14-10. Statsionar 12 Global Beam 40 degrees east longitude (CNN International.)

Maximum EIRP at	
beam center:	29.5 dBW
1st contour:	28.5 dBW
2nd contour:	27.5 dBW
3rd contour:	26.5 dBW

Fig. 14-11. Statsionar 13 Northern Hemispheric Beam 80 degrees east longitude (The Asian Network and Intervision news feeds.)

Maximum EIRP at	
beam center:	32.0 dBW
1st contour:	30.0 dBW
2nd contour:	28.0 dBW
3rd contour:	26.0 dBW
4th contour:	22.0 dBW
5th contour:	12.0 dBW

Epilog

Although we have seen dramatic changes in satellite television technology during the past ten years, the future holds many wonders yet undreamed of. Satellites will have a large impact on the home, which will become much more of an active communications center. Innovative shopping, educational, and audience-participation programs will let you be actively involved in what you are watching.

With satellite telecommuting, you will be able to attend business meetings without leaving your living room. Why spend 18 hours in an airplane to meet with someone in Japan, when you could lease an inexpensive video circuit for your face-to-face encounter? Our access to people and places around the globe will be vastly expanded by succeeding generations of satellites and satellite transmission technologies.

Specialized program services also will appear to serve the specific needs of clubs, hobbyists, and individual enthusiasts; these new channels will benefit from new compression technologies coming our way that promise to dramatically reduce the cost of using a satellite channel by ten-fold or more.

With the arrival of new high-powered DBS satellites later in the decade, satellite TV will become an all-pervasive force with the potential to reach tens of millions of viewers. The cost of receiving systems will come down so that almost everybody will be able to afford one. Moreover, the next generation of Sony Watchman, or its marketplace equivalent, may very well have a built-in satellite antenna, so that you can watch your favorite satellite TV programs right from your office desk, at the ball park, or while frolicking on the beach. Best of all, you won't have to worry about a zoning board or what the neighbors will say when the antenna is no bigger than a pie tin which you can point out a window facing the orbital arc to get a perfect picture.

Although the satellite telecommunications industry has reached a level of maturity, there still is astonishing potential for growth. As the technology advances, the possibilities will continue to expand geometrically. Yet higher frequency bands and even smaller antennas are just beyond the horizon. When they arrive in the 21st century, truly portable satellite communications, both for the uplink and the downlink, will become a reality. The marriage of artificial intelligence with space technology also will usher in a new era of robotic satellites that will interact by means of multiple frequency bands to directly relay satellite signals around the globe. Twenty years from now, we will look back on the 1980s—when satellite TV first became a reality for the masses—with the kind of nostalgia normally reserved for Kitty Hawk and the Model T.

Appendix A
Interpreting Satellite Footprints

There are many factors which help to determine the dish size for any given satellite receiving system: the satellite frequency being received, the elevation angle of the dish for a given satellite, the amount of free space loss between the satellite and the receiving antenna, threshold C/NR of the satellite receiver, LNB noise temperature, and the bandwidth of the satellite receiver. Whew! The following chart assumes average values (†) for some of the less significant factors while listing several combinations of C- and Ku-band LNB noise temperatures and antenna sizes.

C/Ku-band Satellite TV System Parameters Chart

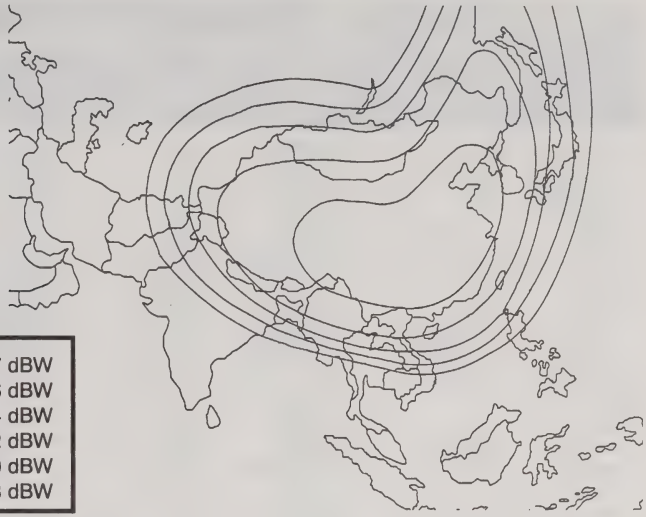
Satellite EIRP	C-band Systems 90 K.	C-band Systems 40 K. LNB	Ku-band Systems 220 K.	Ku-band Systems 120 K. LNB
50 dBW			2 ft.	1.5 ft.
48 dBW			3 ft.	2 ft.
46 dBW			4 ft.	3 ft.
44 dBW			4.5 ft.	3.5 ft
42 dBW			5 ft.	4 ft.
40 dBW	5 ft.	4 ft.	5.5 ft.	4.5 ft.
38 dBW	6 ft.	5 ft.	6 ft.	5 ft.
37 dBW	7 ft.	6 ft.	7 ft.	6 ft.
36 dBW	8 ft.	7 ft.	8 ft.	7 ft.
35 dBW	9 ft.	8 ft.	9 ft.	8 ft.
34 dBW	10 ft.	8.5 ft.	10 ft.	9 ft.
33 dBW	11 ft.	9 ft.	11 ft.	10 ft.
32 dBW	12 ft.	10 ft.	12 ft.	11 ft.
31 dBW	13 ft.	11 ft.	13 ft.	12 ft.
30 dBW	15 ft.	12 ft.	15 ft.	13 ft.
29 dBW	16 ft.	13 ft.	16 ft.	14 ft.
28 dBW	20 ft.	15 ft.	20 ft.	17.5 ft.
27 dBW	22 ft.	18 ft.	22 ft.	20 ft.
26 dBW	24 ft.	20 ft.	24 ft.	22 ft.

(†) With dish elevation above 20 degrees, 30 MHz receiver bandwidth, 8 dB C/NR receiver threshold, and 55 percent antenna efficiency. Dish elevations below 10 degrees will require larger antennas than the sizes listed above.

ASIASAT EIRP AND AZ/EL COORDINATES

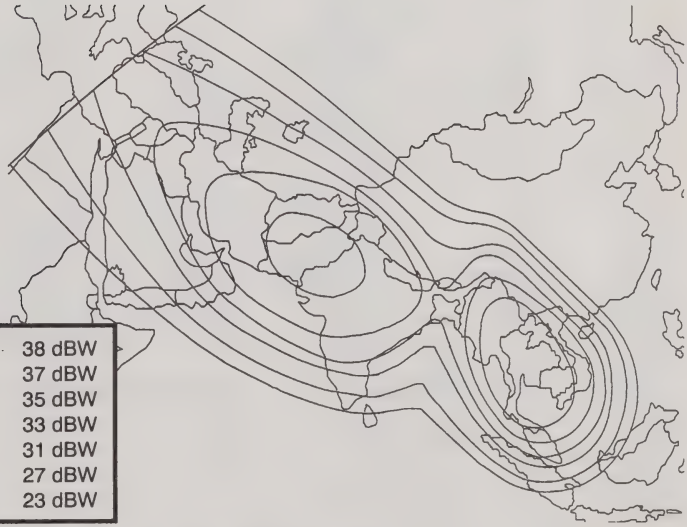
Country	EIRP Range	Major City	EIRP	TVRO	Elevation/Azimuth	
China	32~36 dBW	Shanghai	36 dBW	1.8m	50	209
Japan	30~34 dBW	Tokyo	30 dBW	3.7m	35	229
South Korea	35~35 dBW	Seoul	36 dBW	2.4m	42	213
North Korea	35~35 dBW	Pyongyang	36 dBW	2.4m	40	213
Mongolia	30~34 dBW	Ulan Bator	32 dBW	3m	35	182
Georgia (CIS)		Tbilisi	32 dBW	3m	13	110
Russia (CIS)		Vladivostok	34 dBW	2.4m	33.7	216
		Irkutsk	30 dBW	3.7m	30.2	178
		Astrakhan	30 dBW	3.7m	12.3	114
		Rostov	30 dBW	4.5m	7.6	108
Ukraine (CIS)		Sevastopol	30 dBW	4.5m	4.1	103
Armenia (CIS)		Yerevan	32 dBW	3.5m	13.3	110
Azerbaijan (CIS)		Baku	33 dBW	2.4m	17.1	114
Turkmen (CIS)		Ashkhabad	35 dBW	2.4m	23.5	121
Uzbek (CIS)		Tahkent	34 dBW	3m	30	132
Tadghik (CIS)		Dushanbe	35 dBW	2.4m	31.4	130
Kirgiz (CIS)		Osh	33 dBW	3m	32.5	135
Taiwan	33~35 dBW	Taipei	35 dBW	2.4m	55	215
Hong Kong	35 dBW	Hong Kong	35 dBW	2.4m	62	202
Philippines	Up to 31 dBW	Manila	28 dBW	5m	65	227
Vietnam	34~36 dBW	Hanoi	35 dBW	3m	65	180
Kampuchea	36~37 dBW	Phnom Penh	37 dBW	1.8m	76	177
Laos	36~37 dBW	Vientiane	37 dBW	1.8m	69	171
Thailand	35~37 dBW	Bangkok	37 dBW	1.8m	73	160
Malaysia	Up to 35 dBW	Kuala Lumpur	35 dBW	2.4m	84	127
Singapore	32 dBW	Singapore	32 dBW	3m	88	130
Indonesia	Up to 33 dBW	Medan	31 dBW	3.5m	81	115
Myanmar	33~37 dBW	Rangoon	32 dBW	3m	68	150
Bangladesh	33~35 dBW	Dhaka	33 dBW	3m	58	146
India	23~37dBW	New Delhi	37 dBW	1.8m	45	132
Bhutan	33~34 dBW	Thimbu	33 dBW	3m	53	149
Nepal	33~35 dBW	Kathmandu	34 dBW	3m	52	146
Pakistan	35~37 dBW	Karachi	37 dBW	1.8m	40	119
Afghanistan	35~37 dBW	Kabul	37 dBW	1.8m	34	128

Asiasat North Beam Coverage from 105.5 degrees east longitude



Beam center EIRP:	37 dBW
1st contour:	36 dBW
2nd contour:	34 dBW
3rd contour:	32 dBW
4th contour:	30 dBW
5th contour:	28 dBW

Asiasat South Beam Coverage from 105.5 degrees east longitude



Beam center EIRP:	38 dBW
1st contour:	37 dBW
2nd contour:	35 dBW
3rd contour:	33 dBW
4th contour:	31 dBW
5th contour:	27 dBW
5th contour:	23 dBW

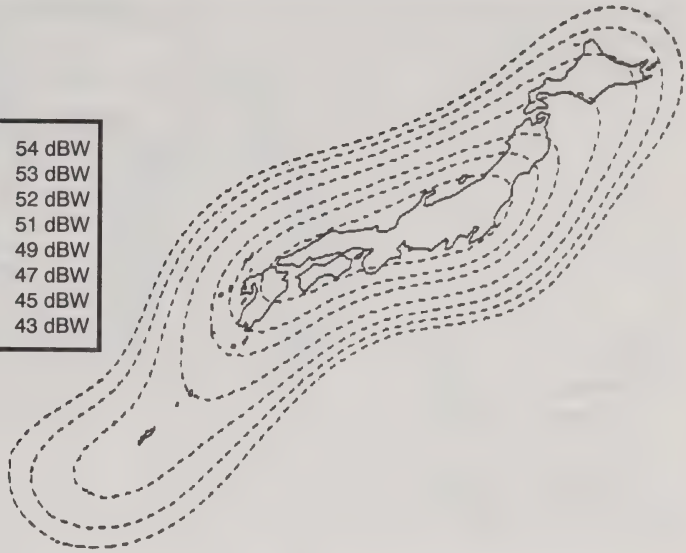
ASIASAT 1 FOOTPRINT COUNTRIES: STAR TV

COUNTRY	STAR HH	LOCAL TV HH	# CHANNELS	LANGUAGE	OWNERSHIP
Afghanistan	10	100,000	One	Dari & Pashtu	Government
Bahrain	—	145,000	Two	Arabic /Engl.	Government
Bangladesh	200	400,000	One	Bengali/Engl.	Government
Bhutan	0	N.A.	—	—	—
Brunei	20	67,000	Two	Malay/Chinese	Government
China	50,000	121,000,000	Three	Mandarin	Government
Cyprus	0	175,000	Two	Greek/Turk.	Public/Private
Egypt	20	4,100,000	Five	Arabic/Fr.	Government
Hong Kong	48,000	15,000,000	Four	Chinese/Engl.	Private
India	175,000	20,000,000	One	Hindi/Engl.	Government
Indonesia	11,000	20,000,000	Two/Two	Indonesian	Govt/Private
Iran	0	2,400,000	Two	Farsi	Government
Iraq	0	620,000	Two	Arabic	Government
Israel	184,000	705,000	Two	Hebrew/Engl.	IBC/SCPM
Japan	244	37,900,000	Two/Five	Japanese	Public/Priv.
Jordan	0	285,000	Two	Arabic	Government
Kampuchea	0	55,000	One	Khmer	Government
Kuwait	700	680,000	One	Arabic	Government
Laos	0	35,000	One	Laotian	Government
Lebanon	50	520,000	N.A.	N.A.	N.A.
Macau	200	150,000	Two	Port./Engl/Ch.	Private
Malaysia	10	2,523,000	Two/One	Malay	Govt/Priv.
Mongolia	50	88,000	Two	Mongolian	Government
Myanmar	20	68,000	One	Burmese	Government
Nepal	30	50,000	One	Nepali	Government
North Korea	0	1,050,000	Two	Korean	Government
Oman	20	225,000	One	Arabic/Engl.	Government
Pakistan	8,244	1,800,000	One/One	Urdu/English	Govt/Priv.
Philippines	44,965	5,470,000	One/Four	Filipino/Engl.	State/Priv.
Qatar	50	170,000	Two	Arabic	Government
Saudi Arabia	N.A.	3,950,000	Two	Arabic/Engl.	N.A.
Singapore	10	613,000	Three	Mand/Engl.	Government
South Korea	282	10,597,594	Two/One	Korean	Government
Sri Lanka	50	700,000	Two	Sinhala/Tarm.	Government
Syria	50	685,000	Two	Arabic/Engl.	Government
Taiwan	170,000	4834694	Three	Chinese	Government
Thailand	8,000	6,875,220	Five/Six	Thai/Engl.	State/Priv.
UAE	N.A.	150,000	One	Arabic/Engl.	Government
Vietnam	30	3,500,000	Three	Vietnamese	Government
Yemen	10	97,000	Two	Arabic/Engl.	Government

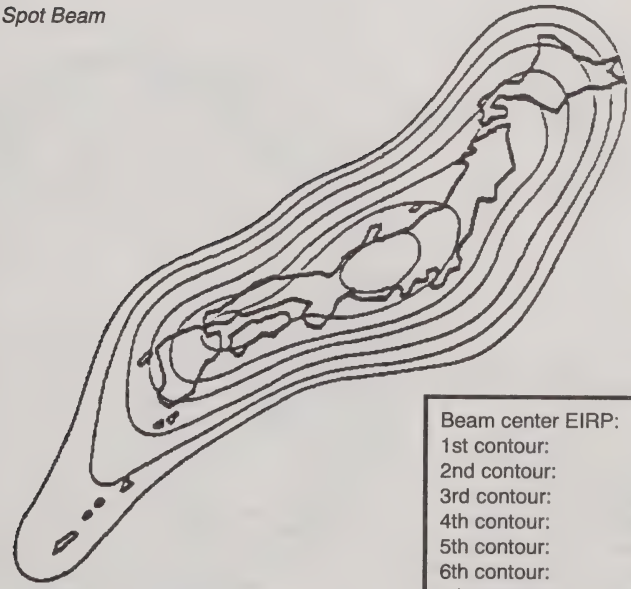
TOTAL STAR TV HOUSEHOLDS = 701,365 (SOURCE: STAR TV (As of early 1992)

Superbird Ku-band Spot Beam Coverage from 158 degrees east longitude

Beam Center:	54 dBW
1st contour:	53 dBW
2nd contour:	52 dBW
3rd contour:	51 dBW
4th contour:	49 dBW
5th contour:	47 dBW
6th contour:	45 dBW
7th contour:	43 dBW

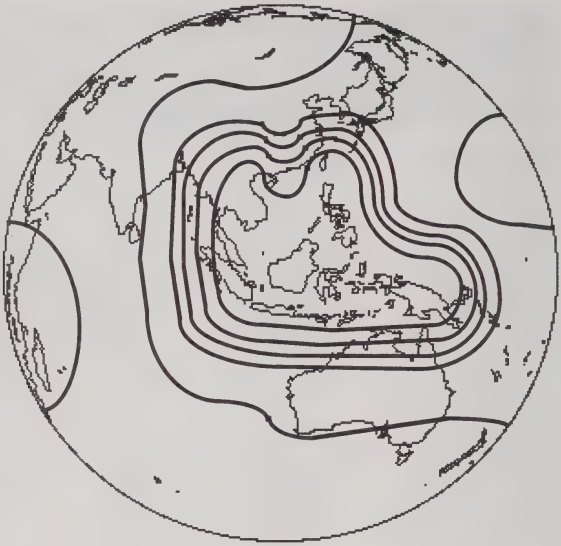


JCSat Ku-band Spot Beam



Beam center EIRP:	53 dBW
1st contour:	52 dBW
2nd contour:	51 dBW
3rd contour:	50 dBW
4th contour:	48 dBW
5th contour:	46 dBW
6th contour:	44 dBW
7th contour:	42 dBW

Palapa B2P Spot Beam Coverage from 113 degrees east longitude



EIRP at	
Beam Center:	36 dBW
1st contour:	34 dBW
2nd contour:	32 dBW
3rd contour:	30 dBW
4th contour:	26 dBW
5th contour:	16 dBW

Aussat A National Beam (Feeds for Networks 7, 9, & 10, ABC Interchange, teleconferencing & SCPC radio services)

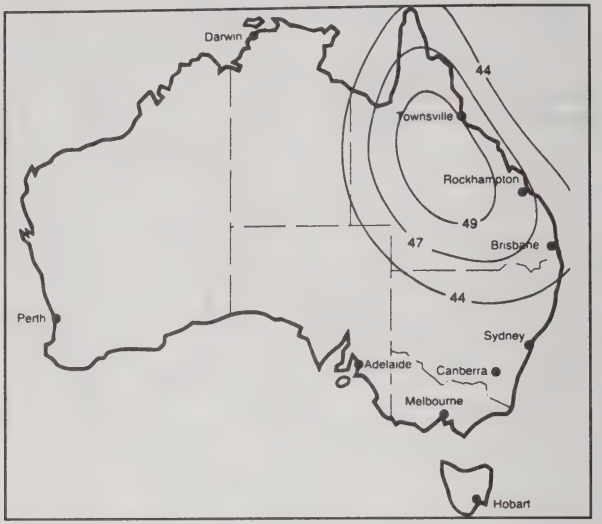
Transponders 9, 11, & 13

	12/30 watts
Beam center:	40/42 dBW
1st contour:	38/40 dBW
2nd contour:	36/38 dBW
3rd contour:	34/36 dBW
4th contour:	30/32 dBW
5th contour:	20/22 dBW

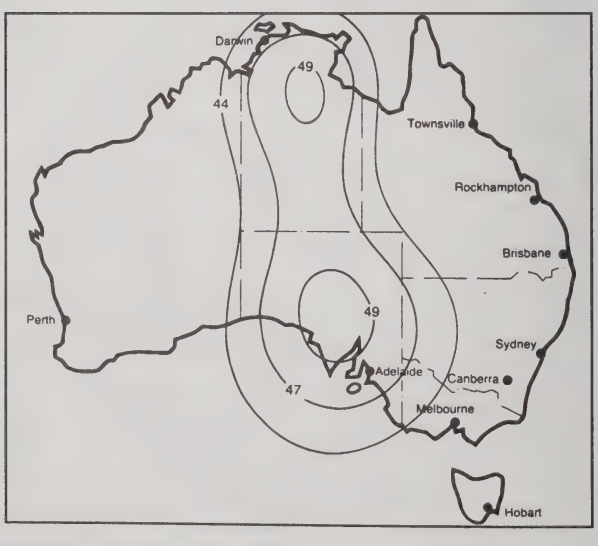
Predicted Minimum EIRP (dBW) for the Aussat A 30-watt Western Australia Beam (Aussat A2: RCTS: Golden West & ABC HACBSS)

Predicted Minimum EIRP (dBW) for the Aussat A 30-watt South East Beam (Aussat A1: Specialized Broadcast Service & ABC HACBSS)

Predicted Minimum EIRP (dBW) for the Aussat A 30-watt North East Beam (Aussat A1: ABC HACBSS & RCTS: Queensland Satellite TV)



Predicted Minimum EIRP (dBW) for the Aussat A 30-watt Central Australia Beam (Aussat A2: ABC HACBSS & RCTS: Imparja)



Appendix B: TV Distribution Satellites (ITU Region 3)

AS OF APRIL 15, 1992

○ = Ku-/Ka-band
● = C-band only
⊘ = C-/Ku-band
⊕ = UHF only
◍ = Ku-band only
○ = C-/S or C-/Ka

Statsionar 5 53° E— ●
Intelsat V F7 57° E— ⊘
Intelsat VI -F4 — ⊘
60° East
Intelsat VA-F11 — ⊘
63° East
Intelsat V F5 66° E— ⊘
Statsionar 13 80° E— ●
Insat 1D (India) 82.9° E ○
DFH2-A1 (PRC) 87.5° E— ●
Statsionar 6 (CIS) 90° E ●
Statsionar 14 (CIS) 96° E ●
DFH2-A3 (China) 98° East — ●
Statsionar-T (CIS) 99° East — ⊕
Asiasat [China] 105.5° East — ●
Palapa B2R (Indonesia) 108° East — ●
BS-3A & **BS-3B** (Japan) 110° East — ◍ ◍ ● ● ● ○ ○ ● ○ ○ ◍ ◍ ◍ ◍ ◍ ⊘ ⊘ ●
DFH2-A2 (PRC) 110.5° East
Palapa B2P (Indnsa.) 113° East
Palapa B4 (Indnsa.) 118° East
CS-3A (Japan) 132° East
CS-3B (Japan) 136° East
Statsionar 7 (CIS)140° East
JCSat 1 (Japan) 150° East
JCSat 2 (Japan) 154° East
Aussat A2 (Australia) 156° East
Aussat A1 (Australia) 160° East
Superbird B (Japan) 162° East
Aussat A3 (Australia) 164° East
Intelsat VA F10 174° East
Intelsat V F3 177° East
Intelsat V F8 180° East
Intelsat V F1 183° East
TDRS-C [NASA] 185.7° East

KEY TO ABBREVIATIONS

Satellites

A=Aussat
I=INTELSAT
P-B1=Palapa B1 [Indonesia]
SCC=Superbird
Abs.=Arabsat
Ins.=Insat
P-B2P=Palapa B2P [Indonesia]
Stat.=Statsionar [USSR]

Satellite Beam Coverage

NE=North East Australia
SE=South East Australia
NA= National A Beam Australia
SWP=South West Pacific Beam
NH=Northern Hemispheric
NB=Northern Beam (Asiasat)
SB=Southern Beam (Asiasat)
WH/EH=West /East Hemi
Z=Zone Beam (Arabsat)
S=Spot Beam
WA=Western Australia
NB=National B Beam Australia
CA=Central Australia Beam
WB=Wide Beam
Z/NE=Zone/North East
Z/NW=Zone/North West
Z/SE=Zone/South East
Z/SW=Zone/South West
G=Global Beam

INTELSAT
W 0174-510/ EARLY '94
C 0179-511/ MID 94
E 0180-508/ EARLY 96
ON THIS ONE NOW

Satellite Polarization

H=Horizontal
V=Vertical
L=Linear
LH=Left Hand Circular
RH=Right Hand Circular

W 2 PGMS 23, 24
C 2 PGMS 23, 24
E - 1 PGM

Miscellaneous

BW=Bandwidth
E/W=East/West Longitude
Freq.=Center Frequency in GHz
Occ.Video=Occasional Video feeds
SCPC=Single Channel Per Carrier
U or L=Upper or Lower Half Transponder
RCTS=Rural Community TV Service
FM=Frequency Modulation
IF= LNB Intermediate Frequency
PCM=Pulse Code Modulation
CIS=Commonwealth of Independent States [formerly U.S.S.R.]
HACBSS=Homestead and Community Broadcast Satellite Service (Australia)
Tr.=Transponder (For C-band satellites: 1st no. set = designation; 2nd set = nearest equivalent 24 channel U.S. satellite receivers. All high power DBS Tr. numbers are WARC '77 designations.)
EIRP= Effective Isotropic Radiated Power
dBW= deciBels referenced to 1 watt of power.

[Note: Beam-center EIRP ratings for international satellites based on observations by reporting stations.]

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
INTELSAT V, VA & VB SATELLITES								
I-V-F8	180 E	42[05]	Z/NW	LH-3.799	22	**CNN International**	6.65 MHz	29 dBW
I-V-F8	180 E	44[13]	Z/NW	LH-3.967	22	**NHK/TV Tokyo/ABC**	6.6 MHz	29 dBW
I-V-F8	180 E	35[18]	G	RH-4.045	22	**RFO France TV** (from Tahiti in SECAM)	6.65 MHz	29 dBW
I-V-F8	180 E	37[22]	G	RH-4.135	27	**AFRTS-Pacific** [Encrypted – B-MAC] Auxiliary services: AFRTS Radio	B-MAC B-MAC	29 dBW
I-V-F8	180 E	38[23]	G	RH-4.167	20	**Occasional Video-** Keystone/KDD Japan news feeds [NTSC – Clear]	6.65 MHz	22 dBW
I-V-F8	180 E	38[24]	G	RH-4.187	20	**TV New Zealand-** News and Sports Feeds including BBC/Sky/ ITN News to New Zealand	6.65 MHz	22 dBW
I-V-F3	177 E	11[1]	WH	RH-3.719	27	**ESPN – U.S.** [Encrypted – B-MAC]	B-MAC	29 dBW
I-V-F3	177 E	11[3]	WH	RH-3.766	36	**LA to Channel 10 Aust. & TV3 New Zealand** Including CNBC & NHK's "Japan Today"	6.6 MHz	28 dBW
I-V-F3	177 E	12[7]	WH	RH-3.845	36	**CNN International**	6.65 MHz	29 dBW
I-V-F3	177 E	13[09]	WH	RH-3.878	18	**LA to Channel 7 Australia** Vidiplex Frame A: NBC Vidiplex Frame B: CNBC	5.59 MHz 5.73 MHz	26 dBW
I-V-F3	177 E	13[10]	WH	RH-3.898	18	**LA to Channel 2 Aust.**	6.6 MHz	26 dBW
I-V-F3	177 E	13[12]	WH	RH-3.931	18	**LA to Channel 9 Aust.** Vidiplex Frame A: ABC Vidiplex Frame B: CBS Auxiliary Radio Service:	6.65 MHz 5.75 MHz 5.92 MHz 5.62 MHz	26 dBW
I-V-F3	177 E	14[14]	WH	RH-3.973	27	**Worldnet/CSPAN** Voice of America	6.65 MHz 7.02 MHz	29 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
I-V-F3	177 E	35[18]	G	RH-4.052	20	**Nine Network Aust.**	6.6/6.65 MHz	25 dBW
I-V-F3	177 E	38[24]	G	RH-4.187	20	**WTN** -Pacific Feed	6.65 MHz	25 dBW
I-V-F3	177 E	79	ES	V-11.480	30	**TBS** (CBS/EBN/off hours)	5.8/6.8 MHz	44 dBW
I-V-F3	177 E	79	ES	V-11.510	30	**Fuji TV** (ABC/off hours)	5.8/6.8 MHz	44 dBW
I-VA-F10	174 E	38[23] 38[24]	G	RH-4.166 RH-4.187	20 20	**Occasional Video-** News and sports feeds	6.65 MHz	23 dBW
I-V-F1	183 E	12[05]	WH	RH-3.800	20	**Occasional Video** (U.S. to Hong Kong)	6.6/6.65 MHz	25 dBW
I-V-F1	183 E	71	ES	V-11.015	30	**NTV/TV Tokyo** (NBC News in off-hours)	5.8/6.8 MHz	44 dBW
I-V-F1	183 E	79	ES	V-11.510	30	**TV Asahi** (CNN Domestic in off-hours)	6.8 MHz	44 dBW
I-V-F5	66 E	52[06]	Z	LH-3.835	20	**RTM2 Malaysia**	6.6 MHz	29 dBW
I-V-F5	66 E	15[06]	WH	RH-3.997	20	**Canal France Int.**	5.7 MHz	30 dBW
I-V-F5	66 E	38[24]	G	RH-4.175	30	**Worldnet** [U.S.]	6.60 MHz	29 dBW
I-VA-F11	63 E	54[9]	EZ	LH-3.885	30	**Ch 3 Bangkok, Thail.†**	6.8 MHz	29 dBW
I-VA-F11	63 E	54[11]	EZ	LH-3.920	30	**Ch 9 Bangkok, Thail.†**	6.8 MHz	29 dBW
I-VA-F11	63 E	38[23] 38[24]	G G	RH-4.168 RH-4.188	20 20	**Occasional Video-** News and sports feeds	6.6 or 6.65 MHz	Varies
I-VI-F4	60 E	38[23]	G	RH-4.168 RH-4.188	20	**Occasional Video-** News and sports feeds	6.6 or 6.65 MHz	Varies
	PALAPA SATELLITES							
P-B2P	113 E	3H[5]	S	H-3.800	30	**RCT1 Indonesia**	6.6 MHz	34 dBW
P-B2P	113 E	3V[6]	S	V-3.820	30	**TV3** (System Televisyan Malaysia)	6.6 MHz	34 dBW
P-B2P	113 E	5H[7]	S	H-3.840	27	**CNN International**	B-MAC	30 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
P-B2P	113 E	4V[8A]	S	V-3.850	20	**Ch. 5 Army**, Bangkok	SCPC†	30 dBW
P-B2P	113 E	4V[8B]	S	V-3.870	20	**Ch.7 BBTV**, Bangkok	SCPC†	30 dBW
P-B2P	113 E	5H[9]	S	H-3.880	36	† SCPC Audio feeds for Ch. 5 & 7 and Radio Thailand	SCPC	—
P-B2P	113 E	5V[10]	S	V-3.900	30	**TV1 Malaysia**	6.80 MHz	36 dBW
P-B2P	113 E	7V14]	S	V-3.980	27	**Occasional Video-** [Encrypted—B-MAC]	B-MAC	36 dBW
P-B2P	113 E	8H[15]	S	H-4.000	30	**ABS-CBN Philippines**	5.0 MHz	36 dBW
P-B2P	113 E	8V[16]	S	V-4020	30	**ASEAN/VIZ** news feeds	7.55 MHz	34 dBW
P-B2P	113 E	9H[17]	S	V-4.040	20	**ESPN International** [April 14, 1992; see page 86 for details).	B-MAC	30 dBW
P-B2P	113 E	12H[24]	S	H-4.180	36	**Occasional Video-** News and sports from Australia to Hong Kong, Thailand, and Macao. Includes horseracing out of Perth, Australia and Sky Program feeds.	6.8 MHz	36 dBW
P-B2R	108 E	8H[15]	S	H-4.000	30	**TVRI Indonesia & CPTI Educational TV** (daytime hours)	6.8 MHz	36 dBW
P-B2R	108 E	10H[20]	S	H-4100	30	**Occasional Video-** Perumtel, Indonesia	6.8 MHz	36 dBW

AUSSAT SATELLITES

A1	160 E	01	NA	V-12.277	36	**Network 9 (SPS)** [Encrypted—E-PAL/VAMP] Auxiliary services: Order wire channels: [Wegener]	6.6 & 7.38/7.56 MHz	38 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
A1	160 E	03	NA	V-12.405	36	**Network 7 (SPS)** [Encrypted—E-PAL/VAMP] Auxiliary services: Order wire channels: [Wegener]	6.6 & 7.38/7.56 MHz	38 dBW
A1	160 E	04	NA	V-12.469	36	**Network 10** Interchange News/Promo, including CNN/some Movies [PAL—Clear]	6.6 MHz	38 dBW
A1	160 E	05	SE	V-12.533	27	**Specialized Broadcast Service** (SBS) Ethnic TV Programs [Encrypted—B-MAC] Auxiliary service: MAC-Text: reception hints	B-MAC	45 dBW
A1	160 E	06	NA	V-12.597	36	**Network 10 (SPS)** [Encrypted—E-PAL/VAMP] Auxiliary services: Order wire channels: [Wegener]	6.6 & 7.38/7.56 MHz	38 dBW
A1	160 E	07	SE	V-12.661	27	**ABC HACBSS** [Encrypted—B-MAC] DBS TV Service Auxiliary Services: ABC National Radio ABC Regional Radio ABC Teletext	B-MAC with Stereo audio	50 dBW
A1	160 E	09	NB	H-12.309	36	**Network 9**-[PAL] News/Promo Interchange	6.6 MHz	38 dBW
A1	160 E	11	NE	H-12.437	27	**Q-Net Video** Educational TV programs, including college courses & teleconferencing [Encrypted—B-MAC]	B-MAC	45 dBW
A1	160 E	12	NB	H-12.501	36	**ABC TV** Interchange [PAL—Clear]	6.6 MHz	38 dBW
A1	160 E	13	NB	H-12.565	43	**ABC:** Radio Services	SCPC	

Replaces with opens 81

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
A1	160 E	14	NE	H-12.629	27	**ABC HACBSS** [Encrypted—B-MAC] DBS TV Service Auxiliary Services: ABC National Radio ABC Regional Radio ABC Teletext	B-MAC with Stereo audio	50 dBW
A1	160 E	15	NE	H-12.693	27	**RCTS: QSTV** [Queensland Satellite TV] [Encrypted—B-MAC] Regional DBS TV Service Auxiliary service: MAC-Text TV Guide	B-MAC with Stereo audio	50 dBW
A2	156 E	01	SE/ NA	V-12.277	36	**Occasional Video-** [Aussat TV: PAL—Clear] teleconferences [Available for lease]	6.6 or 6.65 MHz	
A2	156 E	02	WA	V-12.341	36	**Occasional Video-** Aussat Educational [PAL—Clear]	6.6 or 6.65 MHz	
A2	156 E	03	SE/ NA	V-12.405	36	**Occasional Video-** News, sports & teleconferences	6.6 or 6.65 MHz	38 dBW
A2	156 E	05	SE	V-12.533	36	**Technical Advanced Further Education** [TAFE] Educational Programming [PAL—Clear]	6.6 MHz	44 dBW
A2	156 E	07	WA	V-12.661	27	**RCTS: Golden West** [Encrypted—B-MAC] Regional DBS TV Service Auxiliary Services: Perth Rock Radio Teletext: TV Guide	B-MAC with Stereo audio 96 FM Stereo	50 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
A2	156 E	08	WA	V-12.725	27	**ABC HACBSS** [Encrypted – B-MAC] DBS TV Service Auxiliary Service ABC National Radio ABC Regional Radio ABC Teletext	B-MAC with Stereo audio	50 dBW
A2	156 E	12	CA	H-12.501	27	**ABC HACBSS** [Encrypted – B-MAC] DBS TV Service Auxiliary Services: ABC National Radio ABC Regional Radio ABC Teletext	B-MAC with Stereo audio	50 dBW
A2	156 E	14	CA	H-12.629	27	**RCTS: Imparja –** ("Foot from the sky") [Encrypted – B-MAC] Aboriginal DBS TV Service Auxiliary Services: Aboriginal Radio MAC-Text: TV Guide	B-MAC with Stereo audio	50 dBW
A2	156 E	15	CA	H-12.693	27	**ABC HACBSS** [Encrypted – B-MAC] DBS TV Service Auxiliary Services: ABC National Radio ABC Regional Radio ABC Teletext	B-MAC with Stereo audio	50 dBW
A3	164 E	01	NA	V-12.277	40	**Equitorial VSat/** **AAP/SDS:**	SCPC Data	
A3	164 E	03	SE/ NA	V-12.405	36	**Network 9 Australia** [Encrypted – E-PAL/VAMP] Auxiliary services: Order wire channels: [Wegener]	 6.6 & 7.38/7.56 MHz	38 dBW

Moved to 152°
with
A2
Mod Bands

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
A3	164 E	04	PNG /SWP	V-12.469	36	**Occasional Video-** Micronesian TV feeds [PAL—Clear]	6.6MHz	38 dBW
A3	164 E	05	SE	V-12.533	36	**Occasional Video-** Private TV [PAL—Clear]	6.6 MHz	45 dBW
A3	164 E	06	SWP	V-12.597	20	**Occasional Video-** Telecom Corp. N.Z. News interchanges between TV1, 2, & 3 N.Z. & Australian TV Networks [PAL—Clear]	6.6 MHz	34 dBW
A3	164 E	08	SWP	V-12.725	27	**Occasional Video-** Telecom Corp. N.Z. News interchanges between TV1, 2, & 3 N.Z. & Australian TV Networks [PAL, Clear]	6.6 MHz	34 dBW
A3	164 E	11	NE	H-12.437	43	**Q-NET** Voice and Data Service	SCPC	
A3	164 E	13	NB	H-12.565	43	**MacQuarie Radio 2UW Radio Ashley Computer**	SCPC	
A3	164 E	14	CA	H-12.629	27	**SkyChannel** [Encrypted—B-MAC] Auxiliary services: Sky Radio 4 interchange channels 1 data channel featuring promo for pubs & clubs	B-MAC with mono audio	50 dBW
A3	164 E	15	CA	H-12.693	27	**Occasional Video** Sports & special events [Encrypted—B-MAC]	B-MAC with mono audio	50 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
DFH-2 SATELLITES (People's Republic of China)								
DFH-2	87.5 E	7/8	S	H-3.848	30	**CCTV 1- China**	6.6 MHz	32 dBW
DFH-2	87.5 E	11/12	S	H-3.928	30	**CCTV 2- China** Xinjian TV Station (XTV)	6.6 MHz	32 dBW
DFH-2	87.5 E	19/20	S	H-4.078	30	**Xizang TV** (Tibet) Xizang PBS Tibet	6.6 MHz	32 dBW
DFH-3	96.5 E	6	S	RH-3.825	30	**CCTV-1 China**	6.6 MHz	32 dBW
DFH-1	110.5 E	7/8	S	H-3.848	30	**CETV-China**	6.7 MHz	31 dBW
DFH-1	110.5 E	24	S	H-4.178	30	**CETV-China**	6.54 MHz	31 dBW
JAPANESE DBS SATELLITES								
BS-3A	110.0 E	07	S	RH-11.842	27	**DBS-1 [Joho]**	PCM	55 dBW
BS-3A	110.0 E	11	S	RH-11.765	27	**DBS-2 [NHK]**	PCM	55 dBW
BS-3B	110.0 E	05	S	RH-11.804	27	**Japan Satellite Bct.** [Encrypted—COATEC System]	PCM	52 dBW
BS-3B	110.0 E	09	S	RH-11.880	27	**Japan HDTV Tests**	PCM	52 dBW
INSAT SATELLITES (S-BAND)								
Ins-1D	82.9 E	S1	S	V-2.575 V-2.615	36 36	**All India** **Community TV**	5.5 MHz	42 dBW
STATSIONAR SATELLITES								
Stat. 7 [Russia]	140.0 E	6[-1]	S	RH-3.675	36	**Orbita I** Radio Mayak	7.0 MHz 7.5 MHz	44 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
Stat. 7 [Russia]	140.0 E	10[9]	G	RH-3.875	36	**Dub'l 2** Radio Moscow	7.5MHz 7.0 MHz	29 dBW
Stat. 6 [Russia]	95 E	6[-1]	S	RH-3.675	36	**Dub'l 2** Radio Mayak	7.0 MHz 7.5 MHz	31 dBW
Stat. 6 [Russia]	95 E	10[9]	NH	RH-3.875	36	**THVN (Vietnam)** PAL Video Standard	7.5 MHz	31 dBW
Stat. 6 [Russia]	90 E	6[-1]	S	RH-3.675	36	**Dub'l 2** Radio Mayak	7.0 MHz 7.5 MHz	31 dBW
Stat. 6 [Russia]	90 E	10[9]	NH	RH-3.875	36	**Orbita 2**	7.5 MHz	31 dBW
Stat. 13 [Russia]	80 E	6[-1]	S	RH-3.675	36	**Orbita I** Radio Mayak	7.0 MHz 7.5 MHz	44 dBW
Stat. 13 [Russia]	80 E	10[9]	NH	RH-3.875	36	**The Asian Network** TV from India in Hindi & English	5.8 MHz	31 dBW
Stat. 5 [Russia]	53 E	6[-1]	S	RH-3.675	36	**I Programma** [Orbita 4] Radio Mayak	7.0 MHz 7.5 MHz	44 dBW
Stat. 5 [Russia]	53 E	10[9]	NH	RH-3.875	36	**II Programma** [Dub'l 4, CT-2] Radio Mayak	7.5 MHz 7.0 MHz	31 dBW
Stat. 12 [Russia]	40.0 E	6[-1]	S	RH-3.675	36	**II Programma**	7.0 MHz	44 dBW
Stat. 12 [Russia]	40.0 E	10[9]	G	RH-3.875	36	**Cable News Network**	6.65 MHz	29 dBW
Stat. 12 [Russia]	40.0 E	11[10]	G	RH-3.925	36	**Occasional Video** Including News & Entertainment feeds	6.65 MHz	29 dBW

ARABSAT SATELLITES

Abs I-B	26.0 E	1A	Z	L-2.635	30	**TV Egypt**	6.6 MHz	43 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
Abs I-B	26.0 E	17	Z	RH-4.010	32	**TV Morocco 2**	6.6 MHz	31 dBW
				SCPC: 4.0292 GHz		RTM Radio	IF: 1120.8 MHz	
				SCPC: 4.0303 GHz		RTM Int. Radio	IF: 1119.7 MHz	
Abs I-B	26.0 E	15	Z	LH-3.978	25	**TV Mauritania**	6.6 MHz	36 dBW
Abs I-B	26.0 E	23	Z	RH-4.125	32	**Arab States Brdcting**	6.6 MHz	36 dBW
Abs I-C	31.0 E	1A	Z	L-2.535	30	**Middle East Broadcasting Ctr**	6.6 MHz	43 dBW
Abs I-C	31.0 E	7	Z	RH-3.82975	30	**CNN International**	6.6 MHz	33 dBW
Abs I-C	31.0 E	15	Z	RH-3.97775	32	**Saudi 1** [English]	6.6 MHz	36 dBW
Abs I-C	31.0 E	19	Z	RH-4.05175	25	**Saudi 2** [Arabic]	6.65 MHz	31 dBW
Abs I-C	31.0 E	20	Z	RH-4.063	20	**Oman TV**	SCPC	31 dBW
Abs I-C	31.0 E	22	Z	LH-4.099	25	**Doordarshan** [India]	5.5 MHz	36 dBW
Abs I-C	31.0 E	23	Z	RH-4.119	25	**Doordarshan** [India]	5.5 MHz	36 dBW
Abs I-C	31.0 E	24	Z	LH-4.137	25	**Doordarshan** [India]	5.5 MHz	36 dBW
Abs I-C	31.0 E	25	Z	RH-4.171	25	**DDK Panaji** – Tests	5.5 MHz	36 dBW
Abs I-C	31.0 E	26	Z	LH-4.188	25	**Doordarshan** [India]	5.5 MHz	36 dBW
JCSAT SATELLITES								
JCSat-1	150 E	02	S	H-12.283	27	**Occasional Video** News SNG – TV Asahi	6.2 MHz	53 dBW
JCSat-1	150 E	04	S	H-12.313	27	**Occasional Video** News SNG – Tokyo Broadcasting System	6.2 MHz	53 dBW
JCSat-1	150 E	05	S	V-12.328	27	**Color Bars**	6.2 MHz	53 dBW
JCSat-1	150 E	08	S	H-12.373	27	**Occasional Video** News SNG – Fuji TV	6.2 MHz	53 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
JCSat-1	150 E	10	S	H-12.403	27	**Occasional Video** News SNG—Nihon TV Network	6.2 MHz	53 dBW
JCSat-1	150 E	12	S	H-12.433	27	**B-TV/AUCNET/Mazda** [TDM Static Video]	6.2 MHz	53 dBW
JCSat-1	150 E	14	S	V-12.463	27	**P-SAT (MPT-Japan) & Nihon Mercantile TV** [Encrypted]	PCM	53 dBW
JCSat-1	150 E	26	S	H-12.643	27	**Occasional Video** [NTT]	6.2 MHz	53 dBW
JCSat-1	150 E	29	S	V-12.688	27	**Occasional Video** [NTT]	6.2 MHz	53 dBW
JCSat-1	150 E	32	S	H-12.733	27	**Occasional Video** [NTT]	6.2 MHz	53 dBW
JCSat-2	154 E	02	S	H-12.283	27	**Japan Religious Satellite Broadcasting Co. Ltd**	PCM	53 dBW
JCSat-2	154 E	04	S	H-12.313	27	**Nikkei Satellite News**	PCM	53 dBW
JCSat-2	154 E	06	S	H-12.343	27	**Occasional Video** Star Communications	PCM	53 dBW
JCSat-2	154 E	08	S	H-12.373	27	**Channel O** Satellite ABC	PCM	53 dBW
JCSat-2	154 E	10	S	H-12.403	27	**Occasional Video** [Encrypted]	PCM	53 dBW
JCSat-2	154 E	13	S	V-12.448	27	**High-Tech Shower Int.**	PCM	53 dBW
JCSat-2	154 E	14	S	H-12.463	27	**Rainbow Channel** [Encrypted—M System]	PCM	53 dBW
JCSat-2	154 E	16	S	H-12.493	27	**Fantasy Channel** [Encrypted—B-MAC]	B-MAC	53 dBW
JCSat-2	154 E	18	S	H-12.523	27	**Space Showever TV**	PCM	53 dBW
JCSat-2	154 E	19	S	V-12.538	27	**Color Bars**	6.2 MHz	53 dBW
JCSat-2	154 E	21	S	V-12.568	27	**Channel NECO**	6.2 MHz	53 dBW
JCSat-2	154 E	22	S	H-12.583	27	**Japan Sports Channel**	PCM	53 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
	SUPERBIRD B (SCC—JAPAN)							
SCC-B	162 E	03	S	V-12.370	27	**Power Channel**	PCM	53 dBW
SCC-B	162 E	04	S	V-12.410	27	**One World Television/ Universal One Television**	PCM	53 dBW
SCC-B	162 E	05	S	V-12.450	27	**Eisei Channel**	PCM	53 dBW
SCC-B	162 E	06	S	V-12.490	27	**Nihon Cable TV Net.** [Encrypted – Skyport System]	PCM	53 dBW
SCC-B	162 E	07	S	V-12.530	27	**Space Vision Network**	PCM	53 dBW
SCC-B	162 E	08	S	V-12.570	27	**Cable Soft Network**	PCM	53 dBW
SCC-B	162 E	09	S	V-12.610	27	**Super Channel** [Encrypted – Skyport System]	PCM	53 dBW
SCC-B	162 E	10	S	V-12.650	27	**Japan Cable Television** [Encrypted – Skyport System	PCM	53 dBW
SCC-B	162 E	12	S	V-12.730	27	**Star Channel** [Encrypted – Skyport System]	PCM	53 dBW
SCC-B	162 E	17	S	H-12.470	27	**Occasional Video** Supernet	PCM	53 dBW
SCC-B	162 E	19	S	H-12.550	27	**Let's Try/Life Design**	PCM	53 dBW
SCC-B	162 E	22	S	H-12.670	27	**Color Bars**	PCM	53 dBW
	ASIASAT-1 SATELLITE							
A1	105.5 E	2H[3]	NB	H-3.760	36	**Mongolia Television** Mongolia [SECAM]	6.6 MHz	37 dBW
A1	105.5 E	3H[5]	NB	H-3.800	36	**Prime Sports** [STAR TV - NTSC] Mandarin audio English audio (mono)	5.58/5.76 MHz PANDA I stereo 5.94 MHz PANDA I mono 6.20 MHz	37 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
A1	105.5 E	4H[7]	NB	H-3.840	36	**MTV Asia** [NTSC-M] [STAR TV - NTSC] English audio (mono) BBC World Service Radio (1)	5.58/5.76 MHz PANDA I stereo 6.20 MHz 5.94 MHz PANDA I mono	37 dBW
A1	105.5 E	5H[9]	NB	H-3.880	36	**BBC Asia** [STAR TV - NTSC] Mandarin audio English audio (mono)	5.58/5.76 MHz PANDA I stereo 5.94 MHz PANDA I mono 6.2 MHz	37 dBW
A1	105.5 E	6H[11]	NB	H-3.920	36	**Chinese Channel** [STAR TV - NTSC] Mandarin audio BBC World Service Radio (3)	5.58/5.76 MHz PANDA I stereo 6.20 MHz 5.94 MHz PANDA I mono	37 dBW
A1	105.5 E	7H[13]	NB	H-3.960	36	**STAR Plus** [STAR TV - NTSC] English audio (mono) BBC World Service Radio (2)	5.58/5.76 MHz PANDA I stereo 6.20 MHz 5.94 MHz PANDA I mono	37 dBW
A1	105.5 E	9H[17]	NB	H-4.040	36	**Chinese Prov. TV** [Guizhou/Yunnan TV] Provincial Radio	6.6 MHz PAL-D 7.5 MHz	37 dBW
A1	105.5 E	11H[21]	NB	H-4.120	36	**CCTV 1** [MRFTV—China]	6.2 MHz NTSC	37 dBW
A1	105.5 E	4V[8]	SB	V-3.860	36	**Prime Sports** [STAR TV - PAL] English audio (mono) Mandarin audio	6.3/6.48 MHz PANDA I stereo 6.80 MHz 7.2 MHz PANDA I mono	38 dBW
A1	105.5 E	5V[10]	SB	V-3.900	36	**MTV Asia** [STAR TV - PAL] English audio (mono) BBC World Service Radio (1)	6.3/6.48 MHz PANDA I stereo 6.80 MHz 7.20 MHz PANDA I mono	38 dBW

Sat.	Orbit	Tr.#	Beam	Pol/Freq	BW	Service/ Description	Audio Subcarrier	Beam Center EIRP
A1	105.5 E	6V[12]	SB	V-3.940	36	**BBC Asia** [STAR TV - PAL] English audio (mono) Mandarin audio (mono)	6.3/6.48 MHz PANDA I stereo 6.80 MHz 7.20 MHz PANDA I mono	38 dBW
A1	105.5 E	7V[14]	SB	V-3.980	36	**Chinese Channel** [STAR TV - PAL] Mandarin audio (mono) BBC World Service Radio (3)	6.3/6.48 MHz PANDA I stereo 6.80 MHz 7.20 MHz PANDA I mono	38 dBW
A1	105.5 E	8V[16]	SB	V-4.020	36	**STAR Plus** [STAR TV - PAL] English audio (mono) BBC World Service Radio (2)	6.3/6.48 MHz PANDA I stereo 6.80 MHz 7.20 MHz PANDA I mono	38 dBW
A1	105.5 E	9V[18]	SB	V-4.060	36	**Future Service** [STAR TV - PAL]	—	—
A1	105.5 E	10V[20]	SB	V-4.100	36	**Pakistan TV**	6.6 MHz	38 dBW
A1	105.5 E	11V[22]	SB	V-4.140	36	**Myanmar TV** [Burma] [Burma]	6.6 MHz NTSC	38 dBW

Appendix C
A Glossary of Satellite Related Terminology

A

ABC (1)—American Broadcasting Company. Major U.S. network.

ABC (2)—Australian Broadcasting Corporation. Government-run organization which uses Aussat satellites to relay east- and west-coast editions of ABC network television programming to home satellite TV systems throughout the Australian continent.

Analog—A signal waveform that can be continuously variable in intensity and/or frequency. (Also see digital).

AOR—Atlantic Ocean Region (as defined by INTELSAT).

Aperture—The effective diameter of a parabolic antenna which intercepts the incoming microwave signal.

ARABSAT—Arab Satellite Communications Organization with satellites operating from 19 and 26 degrees East Longitude.

ATS—Applications Technology Satellite. Early series of NASA experimental satellites.

Attenuation—The measure of signal loss in a transmission medium or component usually expressed in deciBels (dBs) or deciBels per unit length (kilometer or mile). Satellite transmissions at the higher end of the microwave frequency bands are more susceptible to attenuation caused by heavy rains.

Aussat Proprietary Ltd—Operating company of Australian National Satellite System.

AZ—The azimuth angle (see azimuth).

Azimuth—Angle between the receiving antenna and the longitudinal location of the satellite sub-point over the Earth's equator.

B

Backhaul—A terrestrial link connecting an earth station to its local switching center or population center.

Band—A unit for designating a specific frequency or range of frequencies in the electromagnetic spectrum.

Bandwidth—The range of frequencies occupied by a signal, or passed by a transmission channel. Services requiring a bandwidth greater than 20 kHz, such as TV transmissions, are known as "broadband". Those requiring less capacity, such as audio transmissions, are known as "narrowband".

Baseband—The band of frequencies containing the information, prior to modulation (and after demodulation).

BB—Baseband.

BBC—British Broadcasting Corporation.

BDC—Block Downconverter or Block Downconversion.

Bit—A binary digit. Smallest possible unit of digital transmission.

Bit Rate—Speed of digital trans-

mission, measured in bits per second (bits/s or b/s), or multiples of thousands or millions (Kbits/s or kb/s; Mbits/s or Mb/s).

Block Downconversion—The use of a fixed-frequency first local oscillator, to downconvert an entire satellite band to a lower intermediate frequency for subsequent tuning and demodulation.

B-MAC—See MAC.

Boresight—Axis of symmetry of a parabolic antenna. (In layman's terms: the beam center.)

BPF—Band-Pass Filter.

BS—Broadcasting Satellite (Japan).

BSS—Broadcasting-Satellite Service. (Also see FSS.)

b/s—Bits per second.

C

Carrier—The radio frequency wave that is modulated by the baseband information signal.

Cassegrain—Dual-reflector antenna geometry using a convex hyperboloidal subreflector and paraboloid main reflector.

CATV—Community Antenna (Cable) Television.

C-band—Used loosely for satellite downlinks within the 3.4 to 4.2 GHz frequency range.

CBC—Canadian Broadcasting Corporation.

CBS—Columbia Broadcasting System. Major U.S. network.

Channel—A one-way communications link. The connections for satellite TV transmissions are called channels. The volume of satellite television usage is measured in hours per channel.

Clarke Orbit—see GEO.

CNN—Cable News Network (U.S.). American news service transmitted worldwide via satellite.

CNR or C/N—Carrier-to-Noise Ratio

Collocation—Ability of multiple satellites to share the same approximate geostationary orbital assignment.

Common Carrier—A company providing telecommunications services to users under rates and regulations set by the Federal Communications Commission.

Companding—A noise-reduction technique involving compression applied at the transmitter, with complementary expansion at the receiver.

Composite Baseband—The raw demodulator output, prior to filtering and clamping and (usually) prior to de-emphasis. Contains all transmitted subcarriers. In some receivers this output is not intended for video use, and a roll-off may be applied to the lowest baseband frequencies.

Composite Signal—Ambiguous term, variously used to refer to composite baseband or composite video.

Composite Video—Complete video signal including synchronizing, luminance and color information, with Teletext where transmitted. Does not include audio or data subcarriers.

COMSAT—Communications Satellite Corporation. U.S. corporation providing operational and technical services to INTELSAT, and operating its own domestic satellite systems.

CONUS—contiguous United States.

CP—Circular Polarization.

D

dB—deciBel. A means of expressing ratios logarithmically. Number of dB = 10 x log(base 10) of power ratio. So, 3 dB represents a factor of 2, 10 dB a factor of 10, 20 dB a factor of 100, etc.

dBi—dB antenna gain relative to an isotropic source.

DBS—Direct Broadcasting (by) Satellite to individual homes.

dBW—dB power relative to one watt.

DE—De-emphasis.

Declination—The offset angle of an antenna from its polar mount axis.

De-emphasis—Restoration of flat baseband frequency response after demodulation: the inverse of pre-emphasis.

Digital—Signals which only have two distinct conditions, corresponding to the "on" (1) and "off" (0) logic states. (Also see analog).

Discrimination—Measure of the ability of a component or system to separate wanted from unwanted signals, using some parameter such as polarization.

Discriminator—Type of FM demodulator.

Dispersal—See Energy Dispersal.

Domsat—Domestic Communications Satellite.

Downconversion—Translation of frequency or a block of frequencies to a lower portion of the electromagnetic spectrum.

Downlink—The space-to-Earth half of a two-way telecommunications satellite link. (Also see Uplink).

DRO (or DSO)—Dielectric-Resonator (or Dielectrically-Stabilized) Oscillator. Highly stable oscillator circuit used in LNBs and BDCs.

D2-MAC—see MAC.

E

Eclipse—Period when the satellite passes into the Earth's (or the Moon's) shadow, when power must be drawn from storage batteries.

Eclipse-protected—Refers to a transponder that can remain powered during the period of an eclipse.

Edge of Coverage—Limit of defined service area, typically 3 dB down from beam center, but may be more. Reception is still possible beyond this line. (Also see Spillover.)

EIRP (or e.i.r.p.)—Equivalent Isotropically Radiated Power (or Effective Isotropic Radiated Power). Combined result of transmitter (or transponder) RF power, and transmitting antenna gain.

El/Az (El over Az)—An antenna mount providing independent steering in Azimuth and Elevation.

Electromagnetic Spectrum—The entire range of wavelengths of electromagnetic radiation—including vis-

ible light—which extend from gamma rays to microwaves and radio waves, all of which travel at the speed of light (186,000 miles per second or 300,000,000 meters per second).

Elevation—Angle between antenna beam and the horizon.

Energy Dispersal—A low-frequency waveform added to the baseband signal before modulation to reduce the FM signal's peak power per unit bandwidth, and thus reducing its interference potential.

EUTELSAT—European Telecommunications Satellite Organization.

F

f/D—Focal-length-to-Diameter ratio (of an antenna's reflector).

Faraday Rotation—When peak sunspot activity highly charges the Earth's ionosphere, the vectors of linearly-polarized satellite signals can be rotated or "twisted" through interaction with the Earth's atmosphere.

Feed, Feedhorn—The small, widebeam antenna that illuminates (gathers signal from) the reflector in an antenna system (convention speaks of illumination, even in a receive- only application, as if the antenna were transmitting).

Footprint—Coverage area of a satellite beam; a contour map showing EIRP or antenna sizes within a satellite's coverage zone.

Frequency—The number of times that an alternating current goes through its complete cycle in one second of time. One cycle per second is also referred to as a Hertz, 1,000 cycles per second a kiloHertz, 1,000,000 cycles per second a megaHertz, and 1,000,000,000 cycles per second a gigaHertz.

Frequency reuse—A technique which maximizes the capacity of a telecommunications satellite through the use of spatially-isolated beam antennas and/or the use of dual polarities.

FSS—Fixed-Satellite Service (see also BSS).

G

G—Giga-, one (US) billion or 10^9.

GaAs—Gallium Arsenide. High-mobility semiconductor material used in low-noise microwave devices.

GEO—The Geosynchronous Equatorial (Clarke) Orbit. Unique orbit in which a body can remain essentially stationary relative to Earth coordinates.

Geosynchronous—Prograde orbit having a period equal to that of the Earth's rotation (need not imply geostationary).

Geostationary—see GEO.

GHz—Unit of frequency equal to 1000 MHz, one billion (10^9) cycles per second.

Global Beam—Beam covering the entire visible Earth surface, (42 percent of the globe) as seen from the satellite.

GMT—Greenwich Mean Time. The international universal standard time. See also UT.

Gorizont ("Horizon")—Russian FSS

satellites serving the STATSIONAR system in the C- and Ku-bands.

G/T (G over T)—Gain-to-noise-Temperature ratio of a receiving system; its sensitivity or "figure of merit".

Guard Band—An unused spectra of frequencies which lie above and below each transponder. The guard band helps to prevent adjacent communications signals from interfering with one another.

H

HACBSS—Homestead and Community Broadcasting Satellite Service. Remote area DBS service via AUSSAT.

Half-Transponder—A method of transmitting two TV signals through a single transponder, by reducing the deviation and power allocated to each. Half-transponder TV carriers each operate typically 4 dB to 7 dB below single-carrier saturation power.

HDTV—High Definition Television.

Headend—Central distribution point for a CATV or MATV system.

Head Unit—Alternative term for an LNA, LNB, or LNC. Also called the outdoor unit.

Hemispheric Beam—Shaped beam covering approximately half of the visible Earth's surface (21 percent of the total globe), as seen from the satellite. INTELSAT spacecraft carry east and west hemispheric beams, while Russian Gorizont and Raduga satellites are equipped with northern hemispheric beams illuminating the visible portion of the globe which lies north of the equator.

HEMT—High Electron Mobility Transistor.

Hertz—A unit of frequency. One cycle per second. (Also see frequency.)

High Power Satellite—Satellite with transponder RF power in excess of about 100 watts.

Hz—Hertz—unit of frequency. One cycle per second.

I

IF (or i.f.)—Intermediate Frequency (in a receiver).

Inclination—Angle between orbital plane of satellite and equatorial plane of the Earth.

INSAT—Indian National Satellite System.

INTELSAT—International Telecommunications Satellite Organization (and its satellites). The global telecommunications satellite system. INTELSAT's membership totaled 122 nations in 1992.

IOR—Indian Ocean Region (as defined by INTELSAT).

Isotropic—The property possessed by a hypothetical omnidirectional point-source antenna, the reference for antenna gain measurements.

K

k—Kilo-, one thousand or 10^3

K—see Kelvin.

K-band—The frequency spectrum 10.9 to 36 GHz.

Kelvin, K—Unit of absolute tem-

perature, used in noise measurement. 273 Kelvin equals zero Celsius. Also degrees Kelvin, degrees absolute.

Ku-band—Used by satellite systems employing frequencies between 10.7 and 18 GHz.

L

Latitude—The distance, expressed in degrees, from the Earth's equator to points north or south. The equator is assigned a value of 0 degrees; North and South poles are 90 degrees.

L-band—Used loosely to describe satellite systems downlinking in the region of 1.6 GHz.

LHCP (or LCP)—Left-Hand Circular Polarization.

LNA—Low-Noise Amplifier.

LNB (or LNBC)—Low-Noise Block (downconverter).

LNF—A combination of a feed, automatic polarizer and low noise amplifier in a common package.

Longitude—The distance in degrees from one meridian to any other is defined in terms of degrees of longitude. (Also see meridian and latitude).

Look Angle—The angle between the horizon and the amount an earth station antenna is tilted up to receive signals from, or send signals to, a satellite.

LOS—Line of Sight.

Low Power Satellite—Satellite with transponder RF power below about 30 watts.

M

m—Milli-, one-thousandth or 10^{-3}.

M—Mega-, one million or 10^{6}.

MAC (A-, B-, C- or D-)—Multiplexed Analog Components. An enhanced color TV transmission system developed especially for satellite use. Differences between the various types of MAC have to do with the various types of sound and data channels used.

Marginal—Describes a system operating with nil, or inadequate, signal margin.

MATV—Master Antenna Television—private cable. (Also see SMATV).

MBA—Multiple Beam Antenna.

Medium Power Satellite—Satellite with transponder RF power in the region of 30 to 60 watts.

Meridians—Lines circling from pole to pole which cross each of the 360 degrees which comprise the Earth's equator.

N

NASA—National Aeronautics and Space Administration. U.S. agency which administers the American space program, including the deployment of military satellites via its fleet of space transportation system (STS) space shuttles.

NBC—National Broadcasting Company. Major U.S. TV network.

Noise Figure—Measurement of noise contribution of an amplifier relative to a noise-free amplifier at a reference temperature. Usually ex-

pressed in dB for Ku-band amplifiers.

Noise Temperature—Noise measurement of a system, as the absolute temperature of a resistive source delivering equal noise power. Expressed in (degrees) Kelvin for C-band amplifiers.

NTSC—National Television Standards Committee (of U.S.—used in reference to the U.S. color TV system).

O

Offset-fed Antenna—An antenna whose reflector forms only part of a paraboloid of revolution, usually excluding the pole or apex, such that a front feed causes no aperture blockage.

Orthogonal—Mutually at right angles (e.g., horizontal and vertical polarization, or right- and left-hand circular polarization).

Outage—See Solar Outage and Rain Outage.

P

PAL—Phase Alternation (by) Line. German-designed color TV encoding system.

Palapa—Indonesia/ASEAN regional satellite system.

PAM (PAM-D)—Payload Assist Module (for GEO launches). A type of PKM.

Paraboloid—A parabola of revolution. Classical shape of a satellite antenna's reflector.

PBS—Public Broadcasting System (U.S.).

PCM—Pulse Code Modulation. Coding system for digital audio transmission.

PE—Pre-emphasis.

Planar Array—Flat satellite antenna composed of a gridwork of tiny resonant elements.

Polar Mount—Antenna mechanism permitting steering along the geostationary arc (Clarke Orbit) by rotation about a single axis. Also Equatorial Mount. A classical polar mount has its axis parallel to that of the Earth. Satellite receiving antennas use modified polar mount geometry, incorporating a declination offset.

Polarization—The property by which an electromagnetic wave exhibits a direction (or rotation sense) of vibration, giving the opportunity for frequency re-use by orthogonal polarizations.

Polarizer (also De-Polarizer)—A birefringent component in a waveguide or antenna system, which converts between linear (plane) and circular polarizations. Not a polarization rotor.

Polarotor—A proprietary name for a type of polarization rotor, a transition with a remotely-rotatable probe.

POR—Pacific Ocean Region (as defined by INTELSAT).

Pre-emphasis—A method of improving S/NR in an FM system, by increasing deviation at high (relative to low) baseband frequencies, according to a defined function.

Prime Focus—The focal point of a paraboloid reflector. A feed system placed at that point.

R

Raduga ("Rainbow")—Russian FSS satellite serving the STATSIONAR system in the C-band frequency range.

Rain Outage—Loss of signal (esp. at Ku-band) due to absorption and thermal noise accompanying heavy rainfall.

RARC—Regional Administrative Radio Conference. See WARC.

RF—Radio Frequency.

RHCP (or RCP)—Right-Hand Circular Polarization.

RTL—Radio-Tele-Luxembourg.

S

SAT 1—German cable TV service, distributed by TV Sat, ASTRA, and DFS Kopernikus satellites.

S-band—Satellite downlinks in the region of 2.6 GHz.

S/C—see subcarrier.

Scalar Feed—The wide flare corrugated horn antenna feed, commonly used in C-band home satellite TV receiving systems.

SCPC—Single Channel Per Carrier. A narrowband transmission mode used to relay audio and data information.

SECAM—Sequence Couleur a Memoire. French-designed color TV encoding system.

Sidelobe—Off-axis response of an antenna.

Skew—The difference (real or apparent) in linear polarization angle between two (or more) different satellites, as modified by mount geometry.

SMATV—Satellite Master Antenna Television (see MATV).

S/N—See S/NR.

S/NR—Signal-to-Noise Ratio. A measure of how clean (noise-free) the recovered baseband signal is.

Solar Array—A network of solar cells which generate electricity when exposed to sunlight.

Solar Eclipse—When the Earth shadows the satellite's solar array from the Sun.

Solar Outage—Loss of signal caused by the sun passing through the receiving antenna's beam.

Sparklies—Popular term for impulse noise spikes visible as black or white spots or streaks in the TV picture, at CNR values close to threshold.

Spherical—Simple geometry for feed-steerable or multiple beam antenna.

Spillover—Usable (but often unwanted) signal reaching locations beyond defined Edge of Coverage.

Spot Beam—Beam of circular or elliptical cross-section, covering a defined region of the Earth's surface, small in relation to a global beam.

STATSIONAR—Russian geostationary communications satellite systems.

Subcarrier—An information-carrying wave, which in turn modulates the main carrier in a communications system. Subcarriers are used for color information, TV audio, independent audio, and data transmission.

T

Teletext—Broadcast Videotex. An on-screen text information service transmitted in digital format using spare lines in the VBI of a TV signal.

Threshold—In an FM system, the value of CNR at which the linear relationship between CNR and demodulated signal SNR breaks down. (Also see Sparklies).

Threshold Extension—Techniques for reducing the CNR value at which threshold effects occur.

TI—Terrestrial Interference. Interference to satellite reception caused by ground-based microwave transmitting stations.

Transponder—The equipment forming a single repeater channel on board a satellite.

U

UHF—The spectrum 300 MHz thru 3 GHz. Terrestrial broadcast television occupies 470~890 MHz. The 620~790 MHz band is allocated for community DBS downlinks in developing countries and remote areas.

Uplink—The space-to-Earth telecommunications pathway.

UT—Universal Time. Same as GMT.

V

VBI—Vertical Blanking Interval

VISNEWS—International TV news agency.

VSWR—Voltage Standing Wave Ratio. A measurement of mismatch in a cable, waveguide, or antenna system.

W

WARC—World Administrative Radio Conference. The ITU meetings that work out standards for international radio communications (including satellite TV).

Y

Yagi—A communications antenna consisting of a main metal boom that supports numerous quarter-wave elements. S-and C-band models are available for reception of Arabsat and Asiasat TV services.

Z

Zone beam—Beam pattern, usually a shaped beam, intermediate between hemispheric and spot.

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Mark Long is the world's leading journalist in the field of satellite communications. During the past ten years he has written more than 300 articles for magazines such as *Satellite Orbit, Satellite Direct, Orbit Video, TVRO Dealer, Satellite TV Week, Cable and Satellite Europe, Popular Communications, and Tele-satellit.* Dozens of his articles also have appeared in the newspapers of the *Los Angeles Times Syndicate.* Mr. Long also is the author of several books on satellite communications, including the best-selling **World of Satellite TV, The Down To Earth Guide to Satellite TV, The Ku-band Satellite Handbook,** and the critically-acclaimed **World Satellite Almanac**. More than 400,000 copies of his satellite-related books have been printed.

As president of MLE INC, Mark Long supervises the publication of a variety of periodicals, including the monthly newsletter *World Satellite Update,* the quarterly *World Satellite Transponder Report*, and the yearly *World Satellite Annual*. A long-time radio amateur radio operator (WA4LXC), Mr. Long also is a member of the *American Institute of Aeronautics and Astronautics* and the *International Society of Satellite Professionals*.

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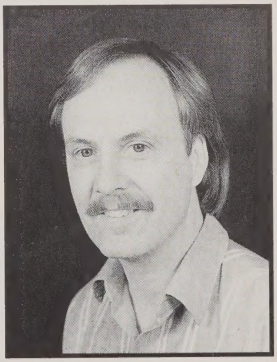

Over the years, Jeffrey Keating has been an FM broadcast station manager, an amateur radio (WB4KDH) net control operator for major relief efforts in Central America, and a pioneer member of the U.S. satellite TV industry. He presently is involved in the establishment of a non-profit satellite TV network for environmentalists and humanitarians.

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